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CONTENTS.

ANNOUNCEMENT

Joseph A. Kucera has joined the staff of this publication as business manager. Mr. Kucera entered the publishing business nine years ago with the Wilson Company, Chicago, where he was business manager of *The Railway Age* and *Electric Railway Review*. On the sale of those properties in 1908, Mr. Kucera went to the McGraw Publishing Company, which purchased the *Electric Railway Review* and consolidated it with the *Street Railway Journal*. Since that time Mr. Kucera has served as business manager of the *Electric Railway Journal*, of the *Electrical World*, and later of both publications.

Mr. Kucera's previous experience covers several years with freight and law departments of western roads, and for three years he was in the employ of the attorneys of the People's Gas Light & Coke Co. Mr. Kucera has a degree of LL.B. and was admitted to practice law in Illinois.

IS WEALTH UNJUSTLY DISTRIBUTED?

There is a conviction abroad, in some quarters, that the wealth of the world is distributed without regard to any standard of justice. Is this conviction well founded or is the situation—viewed from all sides—due to the judgment of an all wise Providence, who has bestowed aptitude and a spirit of thrift among some and a plague of misfortune among others?

Is the world better off at present than it was in the dark ages, or have we descended since that time to conditions under which the human race can now no longer comfortably exist?

These are forceful questions and calm consideration of them will bring but one reply. No one can deny that the wage-earner today, as well as the people in general, are far better off than ever before and that the means of securing happiness are more easily within reach than in any past generation since the introduction of the human race. The demagogue alone walks the land and endeavors to create a feeling of unrest; rails at the abuses of wealth and seeks legislation which savors of confiscation. To change the situation as it now exists permanently would require that human nature itself be remodeled. The law of the land cannot revolutionize the dictates of the great Almighty. His laws are absolute; never changed and never repealed, and so long as the world lasts there will be those who accumulate and those who do not. It may be a sorry world to live in by reason of this; but the truth confronts us. We must view philosophically the inevitable. Wealth goes wherever the genius for creating it lies. Knowing this we can safely presume that if all the wealth in the land were distributed equally among the people—share and share alike—it would be but a question of time only when those who accumulate would be rich once more and those who toil would be toilers again.

During our civil war there were imprisoned at one time in the Confederate stockade at Andersonville 30,000 Union soldiers, coming from all walks in life and from all sections of the North; the good, the bad; the rich and the poor. With starvation and exposure confronting them and in spite of misery at every hand, each one set about to gratify his uppermost natural instinct. The trader began to trade because he could not help it. The banker began to bank for the same reason. The poet wrote verses; the gambler gambled, and the thief plied his profession. All were under like conditions; little to eat, little to wear and little to see. Various groups cliqued together after a time as we find them in our every-day modern city and out of this motley gathering grew a community of beings with all their predominating talents at work as we would find them any where on the globe. Conditions could not change those inherent instincts with which their Creator had endowed them. We can draw our own conclusions from this interesting fact.

If it were possible we might ask would the clever shop man be willing to divide his skill with an incompetent associate? Would the careful engineman be glad to share his good qualities with his neighbor who was in the habit of neglecting rules and regulations to his own detri-

ment as well as his company's? Let the one who feels that such a distribution would be just put himself for a few moments only in the other man's place, for skill and carefulness and all the other human good qualities are just as much wealth as the gold certificate or the gold itself which lies in the treasury to meet it. It needs no long argument to dispose of the claim that wealth seems to be unjustly distributed. We must look to our Creator if redress is wanted and not to the human element—that creator of fleeting and ofttimes unjust legislation. There may be some comfort in knowing that the burdens of the rich man are quite as hard to bear as the cares of the householder who toils by the day and the sweat of his brow. The man who occupies a small cottage with his family around him can defy the world and derive more happiness out of life in the long run than the millionaire with all his disappointments and worldly annoyances. The truth is that wealth has its sacred duty to perform in the world and so has labor, separate and distinct though they may be, yet all for the benefit of mankind.

THE STEEL RAIL SITUATION

Elsewhere in this issue may be found a brief summary of Mr. A. W. Gibbs' address to the American Society for Testing Materials. He deals with the steel rail situation, and points out defects in that society's specification. There are several railroad organizations which have to do with rails, and there are practically as many specifications as there are societies.

Some years ago a state of affairs prevailed in the structural steel industry which without much stretch of imagination may be considered as roughly analagous to the rail situation. Structural steel shapes were designed by the buyer and rolled by the maker, and there came at last to be far too many forms of closely allied shapes. They were not interchangeable and in renewals much inconvenience and delay was experienced. Later the makers, met, discussed the situation, stated the inconveniences and the causes of expensive delay and made definite recommendations. These they carried out. The hetrogeneous mass of nearly-alike, but different, shapes disappeared and the output was standardized, resulting in reduction of cost, elimination of inconvenience, delay, and at once a general feeling of satisfaction became apparent.

The rail situation might be benefited by some such process, say if all the societies appointed competent men, and called in experts from the ranks of the manufacturers, and formed this group into one large joint committee charged with the work of standardizing specifications, so that the result would practically put essentials beyond the power of any to change; great good might be accomplished.

Dr. C. B. Dudley of the N. Y. C. is known to have done much excellent work on standardizing methods of chemical analysis for rails, and also in his specifications he not only stated the chemical composition required, but gave the methods by which the chemical determination was to be made The story is told of a lawyer endeavoring to upset some expert chemical testimony, offered to show the presence of a certain constituent, then in dispute, by testing the leg of the court-room table. He did so, and showed a large percentage of the objectional constituent. As a matter of fact the acid he used contained the constituent, and his demonstration appeared to the court to be conclusive, the judge being ignorant of the method. This crude example may not apply to the chemical tests of rails, but it at least indicates that Dr. Dudley's requirements as to composition of steel and especially of how that composition is to be proved or disproved, has in it an element of the greatest importance.

The preliminary work of the joint committee might well set forth a standard specification, which when put before the full house of each railroad organization, and subjected to the searching enquiry of all the members, as well as discussed and made widely public by the technical press, would have the effect of showing the same target to all, and in criticizing the proposed specification fewer shots would go wide of the mark. As a mere matter of economy of thought and speech, the concentrated attention and deliberation of the several railroad technical bodies, focused each on the same thing, could not fail to produce definite results, or at least, clearly show the points of divergence of opinion and the weak spots, if any, in the joint committee's work.

ABSENT TREATMENT.

Advocates of that successful present day cult called Christian Science, lay quite as much stress upon what they call "absent treatment," as upon the direct personal treatment which a sufferer receives at the immediate hands of the practitioner, who undertakes to heal his patient of a disease or bind up his worldly woes. So that whether the practitioner is at the bedside of his patient or happens to be a thousand miles away his influence is equally propitious. He is able to cure in any event. This is a wonderful belief.

As pertaining to railroads, however, those intricate, inanimate combinations—this sort of treatment can never be successful, although it now is and often has been applied. In other words if the railroad is a thousand miles or more distant from the executive head of it, whose office, perhaps, is in New York, it cannot be expected that his management is direct enough to produce all the good which his responsibility warrants. He cannot be supposed to apply timely remedies, when needed, without personal touch or an immediate prescription. This is not difficult to understand. This method of management, however, is on the wane. It will be better for the railroads when what we sometimes call the "absent treatment" is done away with altogether. With a board of directors in New York and the responsible head established there, too, while the tracks, equipment, most of the subordinate officers and employes are out in Illinois or Kansas or Nebraska or somewhere else in the West or South it is easy to see how matters may go astray, on occasion, and what serious results may come at times.

Even the telegraph or telephone often fails as a suitable medium of communication and the operating head is in consequence, obliged to make a journey East in order to be advised. The needed prescription may not, then, be timely. A further stage of the disease may require other treatment by the time the Vice President has returned.

These may be extreme instances; but, at a glance, we can readily appreciate how unsatisfactory in general the policy is or is likely to be. The "man behind the gun" is often hampered in his operations by the action of a board of directors or executive head, who, by reason of distance, may not be rightly familiar with the object aimed at. An occasional run, over the system, by a committee or the entire board, does not result in over much benefit. A hurried glance here and a look for a moment there give insufficient information upon which to base a good opinion. A responsible operating official, then, curtailed, at times in his actions is not in position to do his best. No one, under pressing influence, can do his best. This is an axiom.

We thus see what so-called absent treatment means when applied to the operation of a railroad. Directors are elected to direct. They should direct and do direct; but they are liable to undertake to direct too many matters of detail. No resolution of a board of directors appeals so agreeably to an operating head as one in which the entire matter—whatever it may be—is "referred to him with full power to act." Such resolutions, however, are not so frequent that he becomes unpleasantly used to them.

If one is capable of handling large affairs he should be entrusted with them fully and held strictly responsible. Business is thereby promptly advanced; the whole machinery of the organization is kept in good running order and the results cannot help but be most satisfactory. "Absent treatment" for a railroad is liable, as we see, to prevent a recovery, in times of distress. At any rate the day of convalescence is likely to be invisible in a dim and far off distance.

CROWDING AUTHORITY HAMPERS RESULTS

There seems to be a growing tendency for state commerce commission to interfere with the functions of the Interstate Commission. Perhaps this is but natural and to be expected. The idea of a commerce commission took its origin from a realization that no body of elected legislators could be as competent to act on the highly technical and abstruse questions of rate making as experts who had made such subjects, rather than practical politics, their life study. In other words, the government made provision for a board of specialists in transporation.

Some of the advantageous results of the Commission's work were uniformity of rates, elimination of indiscriminate passes and ending of rebates, while in another direction the standardization of safety appliances was a great advance. Not that some certain step height, for example, was in itself safer or better than the slightly higher step that had been uniform on one road or the slightly lower step on another. The benefit lies in the fact that now all steps are the same height, and a man who has become accustomed to the position of the step will not find himself uncertain. So much for the federal commission.

State commissions, with more or less control over railroad property and operation, now exist in all but two of our states. They were intended to fulfill the same functions as the Interstate Commission, in providing the state legislature with a body of specialists on whom it could rely. The intra-state jurisdiction of these forty-odd commissions compares closely, for traffic and equipment that does not cross a state line, with the power of the federal Commission in its larger sphere. Already there have been repeated conflicts of authority and jurisdiction as a natural sequence.

In rate making a state line has been made in some cases to assume absurdly important proportions, while in other cases similar laws in adjoining states are so diversely interpreted by rival commissions that equipment which satisfies the law in one state will not measure up to the interpretation of the same law in the next state.

An example familiar to all our readers can be taken from the operation of the state headlight laws in the last five or six years. A commission in one state rules that a law requiring a specified dummy to be visible to an approaching engineman at a given distance is satisfactorily fulfilled by a 16-candlepower incandescent lamp in a 20-inch silvered parabolic reflector. The commission of an adjoining state, working under the same legal requirements, may see fit to order arc lights as necessary to meet the provisions of the law. The first state may rule distinctly against arc equipment as dangerously bright or glaring.

The M. C. B. standards, the R. S. A. standards, the Safety Appliance Committee's standards, all facilitate and simplify railroading, rather than complicate and impede an already burdened industry May we not expect less of this useless conflict of what seems to be almost petty authority, and more of a genuine, open-minded effort to look at the railroads' wellbeing as a vital factor in the welfare of all other industries?

MOST VALUABLE TREE

Loblolly pine, which is known also as short-leaf, and is marketed under the trade name of North Carolina pine, now yields the largest cut of lumber of any tree in Virginia, North Carolina, and South Carolina, and on account of its extremely rapid growth, abundant natural regeneration, adaptability to various soils, heavy yield, and the desirability of its wood for structural purposes, is destined to continue as one of the most valuable timber trees within this area, says a bulletin just issued jointly by the North Carolina Geological and Economic Survey and the U. S. Forest Service. Because of these traits, this pine offers most favorable conditions.

The most economical methods of cutting loblolly pine in different types of forest are detailed, and notwithstanding the tree's rapid rate of growth, it is possible in the case of pure stands in which many trees are small to cut so that timber of a relatively high quality can be secured from later operations. Thinnings are impracticable at present in connection with large operations.

The New York Connecting Railroad

By S. L. Jacobson, formerly Asst. Eng. to the Consulting Engineer N. Y. Connecting R.R.

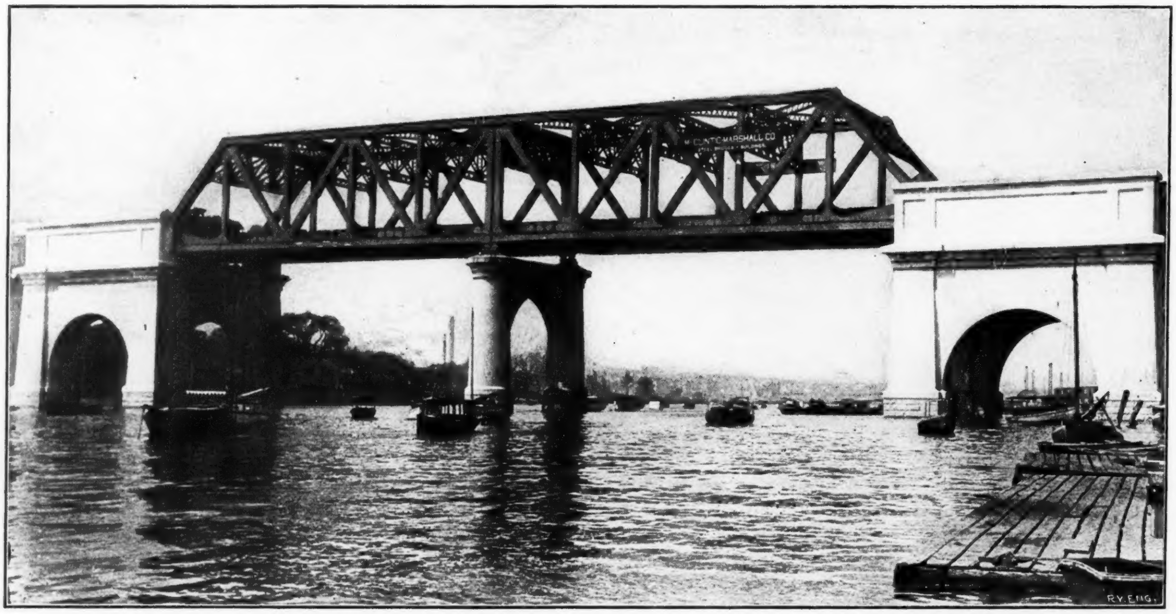
The New York Connecting Railroad will link the New York, New Haven & Hartford and the Pennsylvania systems in an all-rail route from New England and Canada to the South, West and Southwest.

It will connect with the New Haven road in Port Morris, Borough of the Bronx, New York City, just north of the New York & Harlem R. R. branch of the New York Central & Hudson River R. R. Existing tracks afford connection with the New York Central.

From the junction with the New Haven, the New York Connecting R. R. runs parallel with the New Haven tracks to East 133rd Street, the viaduct construction beginning at East 138th Street. At 133rd Street the Connecting R. R. diverges from the New Haven, crosses Bronx Kills on a double-leaf Strauss bascule bridge 350 feet long, skirts the east shore of Randall's Island, crosses Little Hell Gate on a bridge of four fixed spans, eye-bar truss type, about 1200 feet long, then curving through Ward's Island, crosses Hell Gate at its narrowest point, about a mile above the 92nd Street-Astoria ferry, on a steel arch 995 feet center to center of bearings.

Beginning the descent at the Long Island tower of the arch bridge, viaduct construction continues to Lawrence Street, whence reinforced concrete arches and reinforced concrete retaining walls, interrupted by steel bridges across Potter Avenue, and across Steinway and Flushing Avenues, carry the road to and across Stemler Street, Long Island City.

From Stemler Street the road runs through Woodside, Winfield Junction, Columbusville, Middle Village, Evergreen and Ridgewood to the Brooklyn borough line near East New York. This section is the usual cut and fill construction with grade crossings of streets and highways generally eliminated.

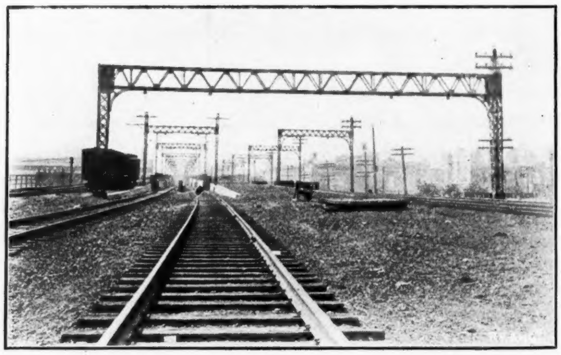


Bronx Kills Bridge. Double-leaf Strauss bascule type. To be used as fixed spans until navigation shall require a drawbridge, when operating parts will be added.

Connections are made with the Sunnyside yard of the Pennsylvania R. R. and with the many divisions of the Long Island R. R.

At the Brooklyn borough line the New York Connecting R. R. joins the Long Island R. R. A tunnel about 3600 feet long, now nearing completion, leads to East New York, where connection is made with the Atlantic Ave. and the Bay Ridge branches of the Long Island R. R.

The total length of the road from Port Morris to the Brooklyn borough line is about 10 miles. The section embracing the Hell Gate arch bridge and its approaches, from Port Morris, The Bronx, to Stemler Street, Long Island City,—known as the East River Bridge Division,—is about 3½ miles long.

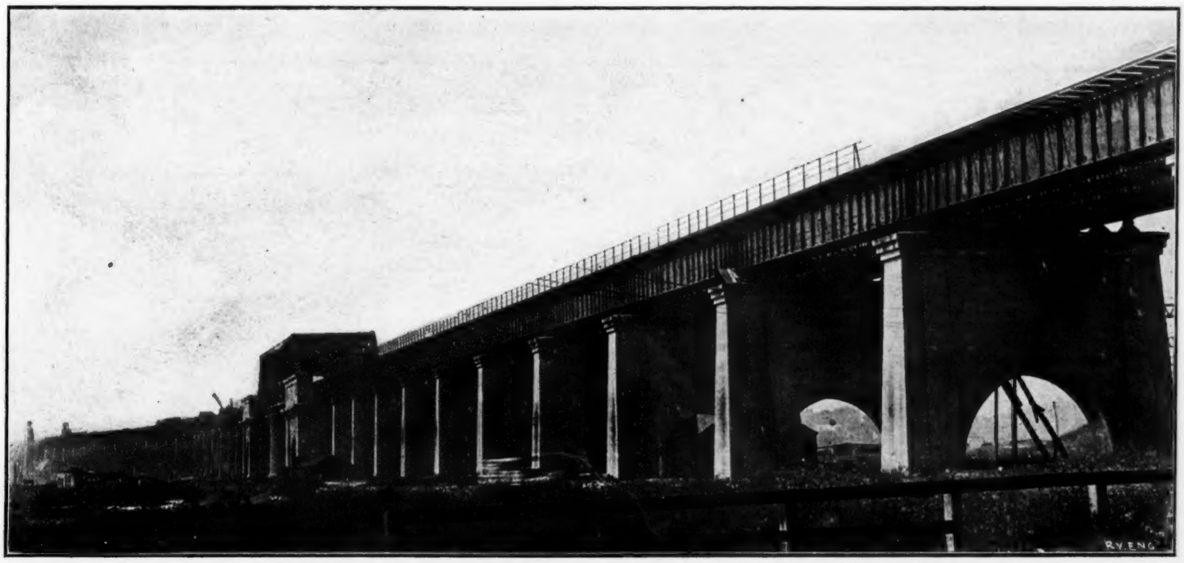


Northern Terminus in the Bronx, showing separation of grades of the N. Y., N. H. and H. R. R. and the New York Connecting R. R., looking south from the N. Y., N. H. and H. R. R. crossing.

A map showing the relation of the New York Con-

necting R. R. to the railroad terminals in New York City and vicinity and the profile and alignment of the East River Bridge Division are shown.

Passenger traffic between New England and Canada and the South, West and Southwest passing over the New York Connecting R. R. will be accommodated by the present Pennsylvania tunnel system—which is a double-track tube for passenger service only—from the Sunnyside yard, Long Island City, under the East River, Manhattan, the Hudson River and the Weehawken hills to the lowlands in New Jersey, passing through the Pennsylvania Station in Manhattan.



Bronx Viaduct from 133rd Street, looking south; showing also Bronx Kills Bridge and Randall's Island Viaduct. The Little Hell Gate Bridge and the Ward's Island Viaduct are seen in the distance.

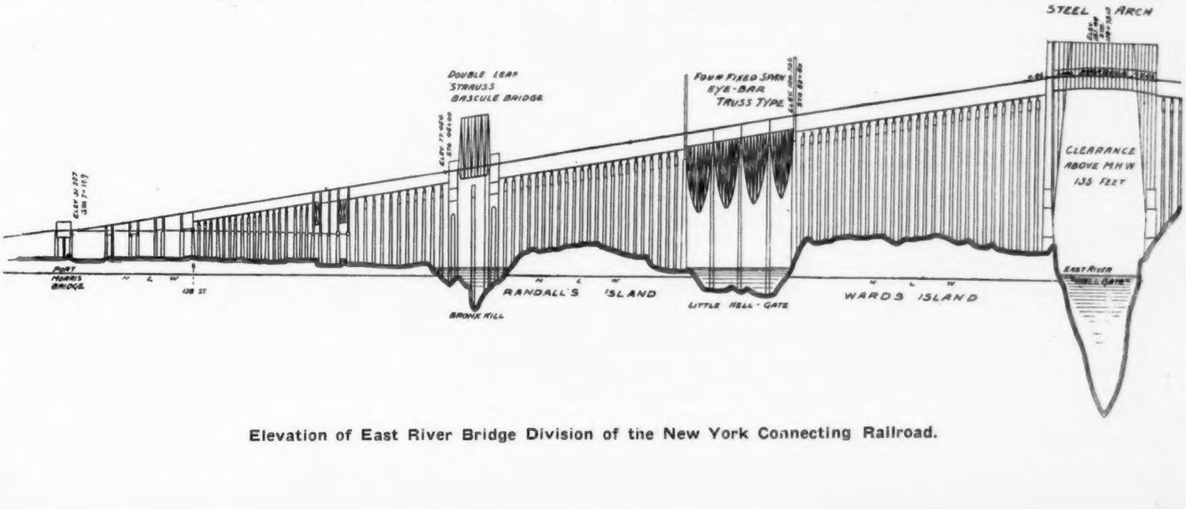
Piers of the Long Island Viaduct. The pier on the right is 71 ft. high, ground line to top of cornice.

Freight traffic will be carried by rail to Bay Ridge and thence by ferry to the Greenville yard of the Pennsylvania R. R., about four miles below the old Jersey City passenger terminal, and vice versa. The project contemplates a double-track tunnel under New York Bay from Bay Ridge to Greenville, affording an all-rail route for freight traffic also.

The East River Bridge Division presents many interesting engineering features.

The bridges and viaducts are designed for Cooper E-60 loading, for four tracks, rock-ballasted. The floors are constructed of 8-in. 20½-lb. I's, 1′ 3″ centers, with tie-rods, and concrete from the bottom of the beams to 3 inches above the top of the beams.

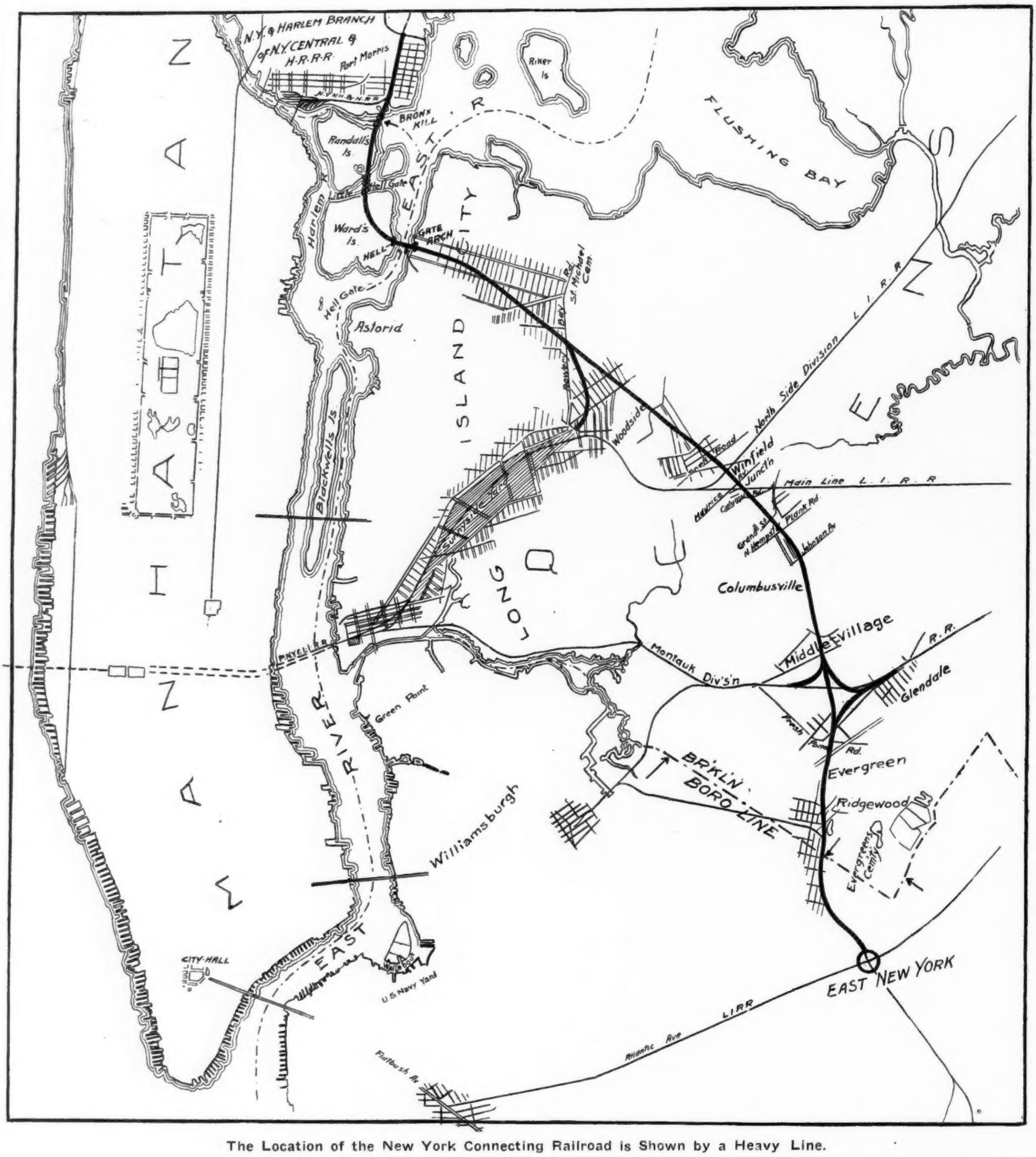
For a portion of the Bronx viaduct the tracks of the Connecting R. R. and the New Haven road alternate in pairs, and typical construction north of 138th Street, except where interrupted by plate girder crossings of 139th, 140th and 141st Street is shown. The outer retaining wall is of concrete reinforced with horizontal and vertical rods and triangular wire mesh, buttressed, resting on wooden piles cut off at constant water-level. The inner retaining



Elevation of East River Bridge Division of the New York Connecting Railroad.

walls—built on the embankment of the New Haven road —are of concrete reinforced with horizontal and vertical rods. The walls are waterproofed with a mop-coating of coal-tar pitch. The outer and the next inner retaining walls are connected with tie-rods surrounded with wire cloth and covered with concrete three inches thick. The plate girder spans on concrete piers with arch openings, on concrete cylinders. The cylinders of the Bronx viaduct extend to depths of between 25 and 50 feet below mean low water.

The abutments and pier of the Bronx Kills bridge rest on concrete cylinders carried to an average depth of 100



The Location of the New York Connecting Railroad is Shown by a Heavy Line.

walls for the inner part of connecting road tracks are of the cellular type, with cross-walls containing tie-rods 20 feet apart. The street crossings are single spans on concrete abutments carried on wooden piles.

The construction from 138th Street to 133rd Street consists of plate girder spans resting on concrete piers on concrete cylinders carried to rock or to satisfactory soil.

From 133rd Street to Bronx Kills the construction is feet below mean low water. The piers of the Little Hell Gate bridge rest on rock at an average elevation of about 15 feet below mean low water. The piers and abutments of these bridges are of conrcete, faced with granite ashlar between two feet below and 16 feet above mean low water.

The Bronx Kills bridge will be fixed spans until navigation shall require its use as a bascule bridge.

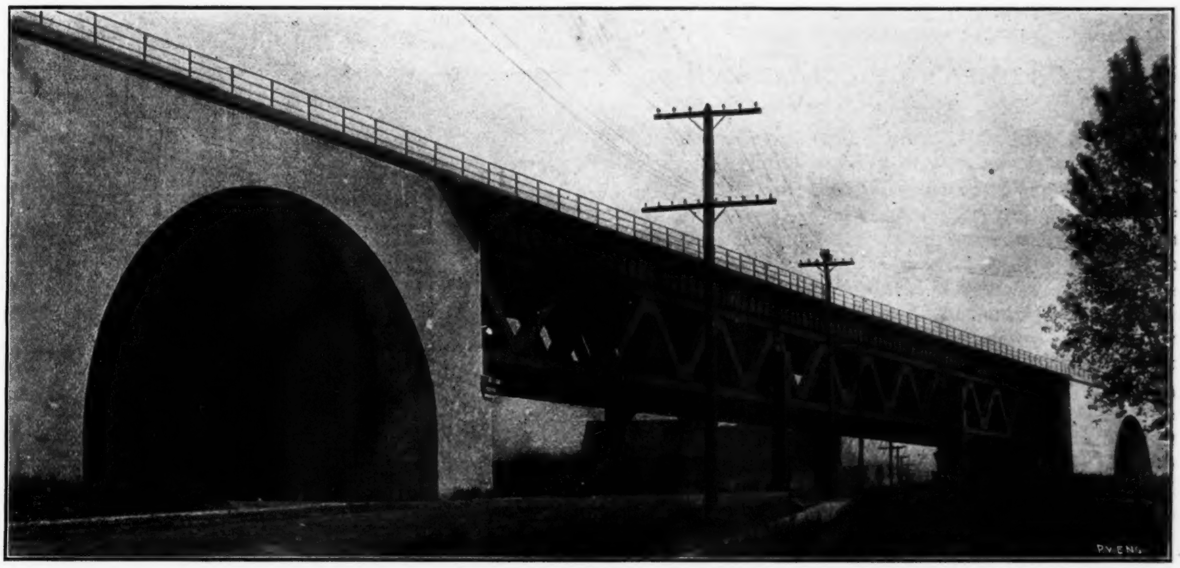
The piers of the Randall's Island, Ward's Island and

Long Island viaducts are of concrete, soil-bearing except in a few cases where rock was encountered close to the surface. Views of these piers are shown.

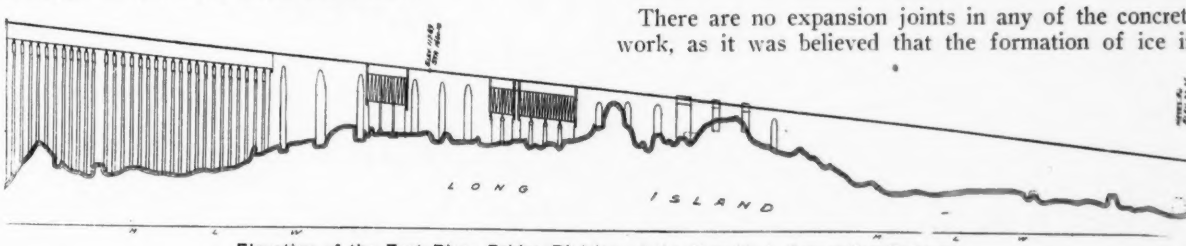
All piers and abutments are reinforced with rods and have I-beams in the coping course to distribute the reactions of the plate girder spans. The concrete is 1:2:4 mixture, the cornice is rubbed to a smooth finish and the body has a picked surface.

The arch bridge will be a single span 977 ft., 6 in., center to center of hinges, 995 feet between centers of bearings, 1016 ft., 10 in., between tower faces. It will consist of two trusses, two-hinge arch, 60 feet center to center. The trusses will be 140 feet center to center of chords at the skew-backs, 40 feet at mid-span. The topmost steel will be 310 feet, and the track 150 feet above mean low water. The clearance above mean high water in the navigable channel will be 135 feet. It will have some of the largest members ever fabricated, single members weighing 185 tons; the total weight of steel will be about 19,000 tons.

The arch bridge towers are of concrete, faced with granite ashlar, 100x140 feet in area at the ground line. The towers will rise to a height of 240 feet. The Ward's Island tower is carried on two piers 30x115 feet, 60 feet centers, taking the thrust of the arch ribs, and on 15 cylinders 18 feet in diameter, taking the dead load of the tower, carried to rock ranging from 35 to 100 feet below mean low water. The Long Island tower rests on rock at about 10 feet below mean low water.



Bridge Across Potter Avenue, Eastern Viaduct, Long Island City. Reinforced concrete arch, 50 ft. street surface to intrados, over Rapelje Street on the left; similar 40 ft. arch over Blackwell Street on the right.



Elevation of the East River Bridge Division of the New York Connecting Railroad.

The retaining walls of the Eastern viaduct range from 30 to 65 feet in height and are three feet thick under the coping, inside face vertical, outside face on a batter of 1:40. They are reinforced with 8-in. 16¼-lb. channels, 10 feet center to center vertically and longitudinally. The walls act as slabs transmitting the loads to tie-rods 2¼ inches diameter at each intersection of the channels. The tie-rods are surrounded with wire cloth and covered with three inches of concrete all around. Cross-walls, one foot thick at the top with a batter of 1:40 on both faces, are spaced about 50 feet apart. The filling of selected material—sand and clay—was rammed in thin layers with pneumatic rammers and is drained to secure thorough dryness.

The concrete arches of the Eastern viaduct, spanning intersecting streets, are soil-bearing; they are reinforced on the intrados and the extrados in two directions, and are waterproofed with a membrane system.

Typical Reinforced Concrete Arch, Street Crossing on the Southern Division.

There are no expansion joints in any of the concrete work, as it was believed that the formation of ice in expansion joints exerts pressures more objectionable than the temperature stresses.

The total estimated cost of the East River Bridge Division is $20,000,000. Construction was begun in

July, 1912, and it is expected to be completed by January, 1917.

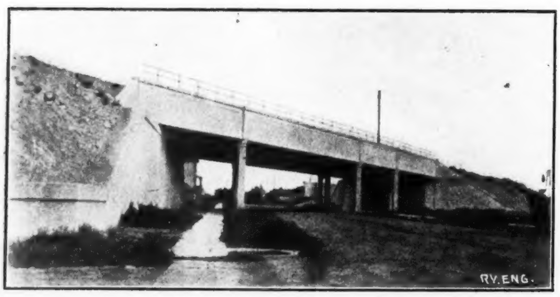
Mr. Gustav Lindenthal, consulting engineer, 68 William Street, New York, designed, and is Chief Engineer of the construction of the East River Bridge Division. Mr. O. H. Ammann is Assistant Chief Engineer.

Mr. A. C. Shaud, Chief Engineer, and Mr. H. C. Booz, Assistant Chief Engineer, Pennsylvania R R., hold the same respective positions on the Southern Division of the N. Y. Connecting R. R., with Mr. C. S. Bissell, Assistant Engineer, in direct charge.

GOVERNMENT BY COMMISSION

Chairman McCall is reported to have emphatically declared at a recent investigation of the Public Service Commission in New York City, concerning subway contracts: "I defy any living human being to place his finger on any act of mine or my predecessors that is open to honest criticism."

Further on, when an intimation was advanced that politics and favoritism had, at times, been injected into the work of this commission, he shouted: "Whoever said that, is an infamous liar." Perhaps the commissioner's challenges were well founded. It is enough, however, that such things should be suggested. It weakens the standing of a great body like a public service commission to have its acts under suspicion, even. So much depends upon the justice that it is called upon to administer that it should, at all times, be, like Caesar's wife—above suspicion. The vast power which the New York State commissions wield courts a danger, not only to the State but to the people and the great corporations which are under their jurisdiction. The law is most extensive in this direction, so much so, that we recall how little some of the Commissioners knew about what their requirements are, at the time of the general investigation of the two State Commissions last spring. A surprising lack of knowledge as to just what the law really contains, was shown. To award an office of this character to one who has displayed political loyalty, alone, is most injudicious. It is the height of folly, even.



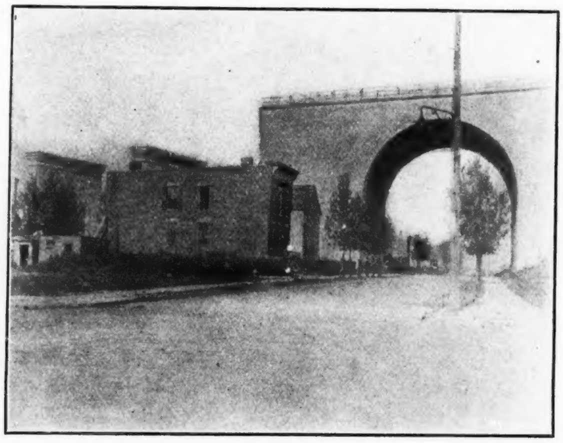
Typical Street Crossing, Southern Division. Steel column, plate girders and I-beam floors, all encased in concrete.

It is an open question, in such circumstances, as to who fares worse, the people or the railroads. Both are assuredly overweighted. It is to be hoped—even prayed for—that under an amended constitution none but top grade and efficient men will be appointed to the bench of this all important institution.

The term of office is such that if men of questionable capacity and standing are selected it will menace the people's rights to an alarming degree. Yes, more. The whole plan of commission government is likely to be ingloriously upset.

FEDERAL VALUATION OF THE RAILROADS

The Railway President Conference Committee have filed a brief of some 500 pages pertaining to this subject of valuation, with the Interstate Commerce Commission. It is a most comprehensive and interesting document. The Presidents Conference Committee represents 214,704 miles of the whole 250,000 miles of railroad in the country, and capital securities outstanding in the hands of the public on June 30, 1913, approximated the vast sum of $15,330,000,000, divided into 60 per cent. of bonds and 40 per cent. of stock, the latter owned by 620,000 stockholders. Over 10 per cent. of all these securities are



Reinforced Concrete Arch, 61 ft. Street Surface to Intrados, over Lawrence Street, Eastern Viaduct, Long Island City. Two piers of the Long Island Viaduct can be seen over the house at the left.

held by insurance companies and savings banks, so that this whole matter is one in which the public are mightily interested. For the fiscal year ending June 30, 1914, the operating revenues were $3,125,000,000, operating expenses over $2,000,000,000, and net revenue over $800,000,000. On June 30, 1913, there were 1,815,239 employees, whose compensation aggregated $1,373,000,000. The railroads paid in taxes for the same period over $120,000,000. The act which established this Federal valuation requires co-operation of railroads and the Interstate Commission. The railroads have been and are doing everything in their power to meet this requirement, and urge a continuance of it, so that the Commission may secure all the necessary facts for its guidance.

Furthermore, the railroads believe that the time is at hand when the principles of law involved should be declared by the Commission for the guidance of the government field parties. The questions now considered correspond in many respects to those heretofore discussed, and are generally confined to the preparation of the inventory and ascertainment of the three cost figures prescribed by the Valuation Act. Here they are:

I. The reasons for the enactment of the Valuation Act of March 1, 1913.

II. Cost of reproduction new.

III. The determination of unit prices.

IV. Appreciation and depreciation.

V. Land.

VI. The meaning of the phrase "owned or used for the purposes of a common carrier."

VII. The Act requires a valuation of all the property owned or used by each carrier, including therein property the cost of which was charged to expenses or surplus.

VIII. The other values and elements of value.

IX. The form of the valuation reports.

Our Offices in the Grand Central Terminal Area

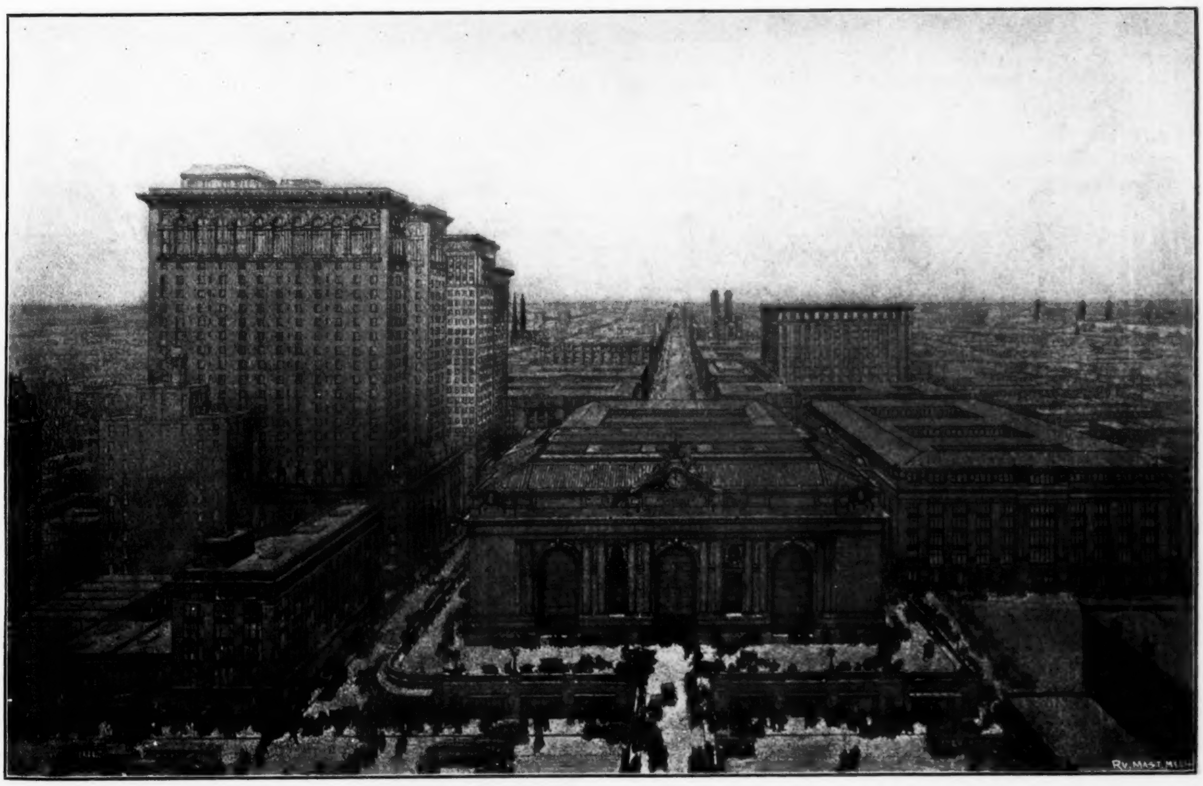
ABOUT the time that this issue of RAILWAY ENGINEERING AND MAINTENANCE OF WAY reaches its readers the Railway Periodicals Company wil be settling in their new quarters in the Vanderbilt Concourse Building. It seems unusually fitting that this paper should be published from an office overlooking, as it does, one of the greatest accomplishments of railroad terminal progress. The Vanderbilt Concourse Building, at the corner of Forty-fifth Street and Vanderbilt Avenue, on the nineteenth floor of which the new offices are located, lies within the area of the terminal, over a portion of the incoming express service tracks.

The great progress in railroading which permits the development of a project of the intricacy of the Grand Central Terminal is being carried here to its most complete fulfillment. By operating all trains entering and leaving the terminal with electricity and below grade, the elimination of smoke, steam and most of the noise and vibration makes possible the use of the same area for offices, hotels, theaters and other buildings which will be made to play their part in making the terminal project self-supporting. From an economic standpoint this use of terminal property for commercial buildings has gone far toward solving the problems of railroads confronted by the necessity of investing in expensive and otherwise non-productive terminal facilities.

One of the largest items that railroads have had to charge to their advertising has been the difference between the cost and upkeep of a modern terminal and that of some much less expensive and extensive building which might accommodate the same number of trains and passengers.

From a standpoint of evolution, the first concessions, such as lunch rooms, news and cigar stands, which were early encouraged in small railroad stations, were followed in the natural growth of the station by the cab stand, the barber shop, the drug store, until now the modern terminal often includes shops to supply every need of the traveler, restaurants which successfully compete for the patronage of the most fastidious, taxicab and transfer stations, to say nothing of offices for the use of all departments of the railroad and even space enough to be rented to the public. The last development has been the handling of traffic in such a way that much of the property is not prevented by its use as a terminal from earning its natural income by the construction of such buildings as might be erected in the heart of a large city.

The Grand Central Terminal comprises an area of seventy-nine acres between Madison and Lexington Avenues, extending north from Forty-second Street to Fifty-sixth Street. Its sixty-seven tracks on two levels, comprising thirty-three and a half miles, give a capacity of 1,053 cars and are handling from seventy-five to one hundred and twenty-five thousand passengers a day with



Grand Central Terminal area. Just level with and to the left of the tips of the spires of St. Patrick's Cathedral near the center of the illustration are the windows of the new offices of of Railway Engineering and Maintenance of Way

a possibility of increase to care for the future. The dominant idea has been to combine beauty and magnitude with convenience and serviceability so that the thousands of travelers from all parts of the country who enter the city each day may go about the terminal with as little that they are located where it is unnecessary to pass through them in going from or to trains. Adjoining the waiting rooms are the men's and women's retiring rooms, barber shop, lavatories and dressing rooms which provide convenient facilities for changing apparel and removing

Looking north on Park Avenue from Our New Offices in the Vanderbilt Concourse Building, showing the area under which the inbound and outbound tracks are laid.

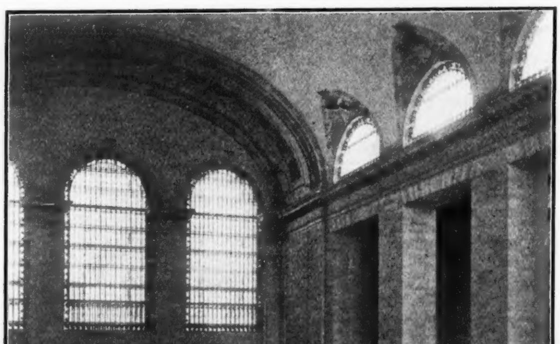
confusion as possible in passing from one room to another. The station was built under traffic and the entire plant changed so that not a vestige of the old remained while eight hundred trains a day were being operated. As each new track or group of tracks was finished a corresponding number of old ones was abandoned and traffic went on without interruption.

The Grand Central Terminal is probably the largest, and promises to be the most successful, combination of the esthetic and practical in city building yet developed in America. Where other idealistic group plans have failed or remained incomplete because dependent upon appropriations by the city, this will succeed because of its earning power. By depressing the tracks below the street level, Park Avenue and the cross streets from Forty-fifth Street to Fifty-sixth Street have been built in, thus reclaiming about twenty city blocks and throwing the entire area open for building purposes. This property over the railroad yards, when leased, will turn in a revenue that will help to pay interest on and to retire the large amount of capital involved in the terminal and the correlated improvements.

In the main terminal building are the waiting rooms, concourses, baggage rooms, retiring rooms, information bureaus and all the other features of a highly developed modern railroad station. The outbound concourse is the principal feature. The facilities afforded the outbound passenger are so arranged that the movement of the traveler is progressive, the ticket window coming first, the Pullman window next, then the baggage checking office and so on,—no steps have to be retraced. From the concourse, passengers proceed to the train room, which is reached by broad ramps of easy grade.

The waiting rooms are unique in station construction in the stains of travel. Adjoining the concourse and the suburban level is the restaurant which takes its place as the peer of any restaurant in the best appointed hotels.

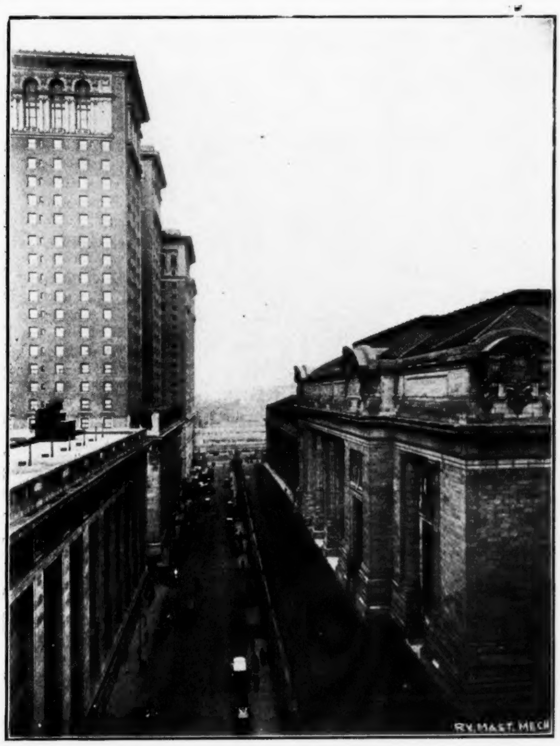
Among the unusual features in the construction of the Grand Central Terminal one of the most interesting is the elimination of stairways by the use of ramps or inclined walks, which provide for the movement of the greatest number of people with the least confusion. The



The outbound concourse of the Grand Central Terminal

grade of these ramps was determined after a number of interesting experiments with temporary ramps and as a result very easy grades were established. Another feature is the complete segregation of the through and local inbound and outbound traffic. This is accomplished by having separate waiting rooms and concourses for the local and through business and a separate station for the incoming traffic. Counter currents of travel and the resultant confusion are thereby eliminated. The tracks are arranged on two levels, the upper for through or express service and the lower for local or suburban service. Both are connected with loops which circle around the main building. Local incoming trains can thus be placed ready to receive outbound passengers on the proper tracks without switching or reversing the position of the engine, as would be necessary in a "stub end" terminal.

The station for incoming travel is located just across Vanderbilt Avenue to the west of the main building. It has subsurface connections with the main building and direct exits to the subway and street. The incoming platforms are so arranged that all passengers leaving the trains must pass in review before the people waiting for them.



Vanderbilt Avenue north from Forty-second Street. The last tall building on the left is the Vanderbilt Concourse Building.

All of the light, heat and power necessary for the operation of the terminal and in fact for all of the buildings to be erected within the terminal area are supplied from a central station where the facilities and experience of the railroads entering combine to ensure economy.

Having thus daily under their constant observation this most wonderful railway terminal accomplishment in America cannot fail to give to the editors and management of Railway Engineering and Maintenance of Way, in their new quarters, an inspiration which will materially assist them in their continuing efforts to make this paper of increasing value and benefit to the railroads and to the railroad men whose interests they most sincerely desire to serve.

ORIGIN OF THE RAILWAY FISH-PLATE

In England, about the year 1847, the "Fish" joint was devised by a man named William Bridges Adams, as it had been found that the ends of the rails, held in "chairs" had a tendency to spring up as a wheel approached them. In time the rail end became hammered out of shape, "broomed," and became otherwise distorted. The deteriorization of the joint resulted in more or less rough riding for those in the coaches, and something had to be done to remedy the evil.

The rails which Adams had to deal with were more or less of the bull-head type. That is, the head of the rail and what we call the flange were nearly alike, and the rail was held in what are called chairs. The chair is spiked or bolted to the tie, and two slightly inward curving horns stand up from the base. This is practically the English and Continental practice at the present time.

When the rail is in place a slightly tapered wooden key is driven in between one horn of the chair and the web of the rail. One may often see plate-layers, as they call section men in England, going along the track, especially on warm, dry days, with a long-handled maul, giving the wooden keys a tap where they have slackened up and backed out a little. The original idea was to turn the rail upside down when worn, and let the wheel run on what was first the underside. Rust and the wear in the chairs prevented this.

Adams found it advisable to have the joints made by two metal keys instead of wood, and he arranged the rails so that the joint would come between sleepers. The chairs were therefore put close together. When the wedges of metal were driven home, the joint was made. This did well enough while the locomotives and cars were not very heavy and the traffic was comparatively light. Later, the fish-plates were bolted through the webs of the rails.

The origin of the word, Fish, in this connection is not at once clear. We use the words fish-beam, fish-plate, fish-bar in mechanics, and though we all know what the words mean, we have to remember the shape of a fish in order to see one of the original applications. Some authorities believe that the word Fish, as used in fish-plate, has been confused with a French word *fiche*, a peg or pin. The original fish joint had a metal peg or pin or key, and it may be believed that this is a highly probable conjecture of the origin of Fish.

A fish, however, is an aquatic animal which tapers toward head and tail, and the sides bulge out to their greatest width about half way between tail and head. In mechanics we speak of a fish-beam as a beam, one of whose sides, commonly the under one, swells out like the belly of a fish. The original metallic "fish" as applied by Adams had just these characteristics. It was a peg, and it swelled out on one side to fit against the chair. The spelling soon became what it is because of the more widely extended knowledge of the swimming creature than of the more restricted mechanical term.

The name has remained although nearly all its original characteristics have disappeared. We now speak of fish-plates which are not pegs or wedges, and are not swelled out to fit any particular form. In fact, some of the modern and heavier pieces used in making a rigid joint cover the web, the flange and the base, and dip down below the joint itself. These heavier forms are frequently called angle-bars, but the use of the word Fish in this connection is so firmly established that no sort of doubt ever arises in the mind of a railway man as to what is meant by the word fish-plate.

Winking Railway Signal Lights, or Steady?

There is a somewhat curious origin to the flash or winking electric street signs which can be seen in any large city. They were designed for economy of current pure and simple, yet it was not for this reason that they became popular. The people who were attracted by the signs did not pay for them. Gradually the fact became apparent that winking signs were most effective in attracting attention, and that they served the purpose of advertising better than anything previously devised.

In the matter of current economy the sum total of the time the lights were out, was in the aggregate quite considerable, and it materially prolonged the duration of each bulb in the sign. Each lamp had a brief rest between flashes, while the "notice-forcing" quality of the whole was enhanced. Its advertising value was really a by-product of economy. The sum of all the brief rests accorded to each bulb is, in a way, like the slight pause made by the human heart after each pulsation at the moment when it is relaxed. Medical men call this the "diastolic sleep" of the heart, and each minute fraction of a second in which our human "power-house" of energy is quiescent builds up a total period of about 28 years' rest in a life of 70; the economy of power due to this form of repose taken by the heart is close upon half of the normal life of man.

The principle of the flash-light has been made use of as an aid to navigation, and these lights have practically displaced the steady light, except in small and more or less unimportant points. The object of the flash-light, as used in navigation, was for identification. Various periods of brightness are arranged to alternate with various periods of darkness in a given time, and when this is duly recorded on a chart, the distinctive character of a light indicates where it is.

An application of the flash or winking light has been made to railway night signals. The scheme has many interesting features and much to recommend it. The light to which we refer is derived from a gas flame and the mechanism is such that a small pilot light is always burning, and the intermittant flow of gas, governed automatically, flares up brightly and dies down, according to the rythmic gush and halt in the eflux of the gas. This produces the flash or winking effect which the company handling it has developed. Apart from the undoubted economy of gas, the automatic extinguishing and re-lighting of the main flame, and the minute series of rests taken by the light are the salient features of this form of signal. We desire briefly to consider some of these features from a purely scientific point of view, and to ascertain something of the validity of any claims which are made for the winking light, as applied to railway signals.

Scientific Considerations

In the first place the gas flame is a good fog-penetrating source of light. This fact was brought out in tests made in 1883 by the British Government at the South Foreland light. The late Prof. John Tyndall was a member of the commission which conducted the experiments. They found that oil and gas flames suffered about equally from atmospheric absorption, but that the electric light suffered very much more per unit of power than either oil or gas flames. It seems, therefore, fair to assume that the gas flame, as used in railway signaling, is probably as satisfactory a form of fog-penetrating light as can be found.

The light in common with other railway signals shines through a modified Fresnel lense, and this insures its concentration into a compact beam of light. With specially constructed reflectors much of the light which otherwise would be lost can be reflected from inside the lamp case, and passed out through the lense. This compact beam shows as a point of light to the observer. This point of light has probably some advantage due to its falling upon a small area on the retina. To appreciate this one must briefly examine the structure of the human eye. There is a spot on the retina of the eye exactly opposite the opening made by the pupil; it is a slight depression or pit and is called the "yellow spot." It is the area of most acute vision. The centre of this yellow spot, which is on the optical axis, is the most highly sensitive spot in the eye. It is the deepest part of the hollow of the yellow spot, and has the acutest color appreciation. This area within the yellow spot is called by scientific men the "fovea centralis." When any object attracts attention, we involuntarily "turn the eyes" so as to see it most clearly in form, color, light and shade. What we really do is to put the eye so that the image of the object shall fall upon the fovea centralis. Opticians call this kind of normal sight, foveal vision, but the ordinary man does not know of this and performs the act involuntarily. Leaving out of consideration the meaning of the scientific term, the idea here is that a point of light falls readily and completely on the area of acutest vision, and whatever advantage there may be, is thus gained, by the concentrated beam of light from a single point.

The distinctive character of the winking or flashing light is that it is intermittant. It does not grow or fade, it does not wax or wane, it bursts at once into full brilliance and is suddenly eclipsed. Such a light at sea would be called an occulting light. This form of light is distinctive and it has this characteristic independent of its color. The light may or may not show any color, but its winking characteristic is easily recognized, and this feature becomes of importance, as when in conjunction with color it tells a two-fold tale.

Railroad Characteristics

The Railway Signal Association has long recognized the desirability of distinguishing automatic block signals from interlocking route signals. This is easily accomplished in the day time, by adding some mark to signal post or semaphore-arm, by which the difference may be known. At night the distinguishing feature is often some kind of marker light, which, while it may serve the purpose desired, tends to complicate the whole matter by introducing an extra light, not used as a signal, upon the attention of the enginemen. The winking light clearly gives the block indication required, and at the same time announces itself as an automatic block signal. The automatic block signal does not really tell an engineman to go on, or to stop, though it may seem to imply these directions. Its concern is to indicate the condition of the track for two blocks ahead, and leave to the observer, the task of making the best use of the information it gives. A broken rail, an open switch, a car, a fallen wire or train ahead is told by the red light on the home signal and the distant signal reproduces the condition of the home signal at the entrance of the block next ahead. There is no coersive necessity for either the immediate stopping of the train, or for the red color on the home signal, but general practice

and custom has indicated that in dealing with fallible human beings both these things seem to be desirable. A red light, however, can penetrate a fog to a greater distance than a white light of the same strength, because the red rays are not so readily dispersed by refraction as white. A red signal lens absorbs such a proportion of the light passing through it as to require a greatly reinforced source of light to produce an effect equal to that of a clear or white lens. Green also requires similar reinforcement.

So far we may conclude the red light can be justified in its position on the automatic signal post. The winking light distinguishes it from the steady, route signal, without introducing a marker or other form of light. Its economy in the use of illuminant is apparent, and its "notice-compelling" quality is one of its strongest features. The fact that it is projected from a single flame makes it fall readily upon that portion of the retina where perception of form and color is most acute. Its sudden luminosity and sudden eclipse provoke the observer's attention, and while he is distinctly made to see the light, its intermittant character, like the diastolic sleep of the heart, actually provides a short period of rest for the retina of the eye, between each stimulation, which is entirely absent in the insistant and monotonous glare of the steady light.

In giving an account of some studies on the perception of movement, color and direction of lights with special reference to railway signaling, Prof. George W. Stratton of Johns Hopkins University says, "The expectation won from the observation of strong lights, which in movement are so attractive to the attention is not met by these weakest ones. We must say, therefore, that the advantage of moving lights is probably confined to those regions of intensity that are well above the threshold of perception." We are here probably justified in considering the winking light as analagous to the swinging lights experimented with in the laboratory of the University, and if this be so, the "attention-compelling" quality of the flashing light has been scientifically established as well as corroborated by the results obtained from advertising flash signs used on the streets.

Psychological Aspect

A rather interesting commentary on the utility of the winking light may be found in the late Prof. William James' work on psychology. In dealing with "Voluntary Attention," in which he says nothing at all about flashing lights, he points out that "There is no such thing as voluntary attention sustained for more than five seconds at a time." In pursuing this point he makes it clear that so-called voluntary attention is really attained by successive efforts to bring the mind to the topic which should occupy the attention. Further on he says: "No one can possibly attend continuously to an object that does not change." If the object is one of sight, concentrated attention eventually causes it to disappear, and sight of it is lost. Part of the cause for this is physical, the reason being that the portion of the retina of the eye, occupied by the image, becomes fatigued and does not, in the end, respond to the rays of light falling upon it. The mind receiving innumerable and different impressions all the time, from sights, sounds, smells, etc., readily loses the object when by reason of the fatigue of the eye it has become invisible.

The fatigue and restoration of retinal areas follow each other very quickly, and in everyday life few people are conscious of the fact. If the object itself does not change, the turning of the eyes or the shifting of the head will bring about the necessary alteration, as when we gaze at some great building or imposing structure. All this is the simple statement of a principle, for it is not to be supposed that the eye of an engineman, on a fast train, can ever be concentrated on a fixed light long enough to fatigue the eye. The fact exists, nevertheless, and we have been compelled to acknowledge the cumulative effect of exceedingly minute pauses or rests, the existence of which are none the less real because they are not often, or readily, perceived. If by any means we work in harmony with the ascertained laws of optics or of psychology, and not against them, then whatever advantage they give we unconsciously appropriate.

In designing the winking or flash signal light for use on railways, what is called the "persistance of vision" has to be taken into account. A flash of lightning occupies an almost infinitesimal fraction of a second, yet we clearly see it as if its duration was for a 1/7 to 1/10th of a second. The glowing end of a parlor match which is but a luminous point, appears to us, when revolved rapidly before the eyes, as a continuous circle of light, because the impression of the match when, say, in the three o'clock position, gives a sensation which persists until perhaps the match has assumed the seven or eight o'clock position, as it may be called, taking the clock dial as our circle of light. Moving picture machines make use of this fact, and completely obscure the entire picture while the mechanism shifts the film. The persistance of vision holds the picture on the darkened screen and prevents it from fading from the eye, until a succeeding portion of the film, showing the objects in a new position, is placed and illuminated.

It would be possible to eliminate the "wink" from the flashed signal, by making the process very rapid, and thus approximating to the "continuous" light of a tungsten bulb, lit by alternating current. This possible elimination of the "wink" is not done in the case of the flash signal, but it indicates the capability of variation in the duration of the flash, which can be made and accommodated to the requirements of any railway using this form of signal.

In giving our readers what facts we have been able to gather concerning the efficacy of the winking or flash signal, we have not sought to dogmatize, nor do we look for more than the careful and comprehending thought on this most important subject.

The winking light appears to us to be based on scientific fact and to merit most careful consideration. We sincerely desire our readers to give us their opinion of the light. Many of them are intimately acquainted with this signal, in actual railway work, and are therefore most competent to tell us, for others, how it appears to them. Those who are familiar with the steady light are also invited to discuss this newer form.

The whole science of railway signaling is of paramount importance. It has its first cost feature, its maintenance charge, but above all other considerations, any system must ultimately stand or fall by its inherent efficacy in affording protection, and it should do this with the least strain on the eye, the mind, or the attention of those who look to it and act. The columns of this paper are open to all grades of railway men who have knowledge, opinions or judgment. Gentlemen of the iron way, we call upon you to speak.

Reports of progress on the American section (I-Kwei) of the Hukuang Railways, in China, indicate that a new trace has been found by R. W. Randolph, engineer-in-chief, under whom the survey has been proceeding. The work will involve difficult construction owing to the hilly character of the country. The German section was delayed on account of the difficulty of negotiating a supplemental loan. It is understood that guarantees have been furnished which will insure the completion of the work. On the British section the work as far as Changsha is well under way.

STRIKING EXHIBIT AT THE PANAMA-PACIFIC

Undoubtedly every one of the more than eleven million persons who have so far been to the great San Francisco Exposition, as well as those who still have this treat in store, will be interested to learn that the mammoth electric locomotive mounted on the turntable in the Transportation Palace has received the Grand Prize, the highest award in the gift of the exposition.

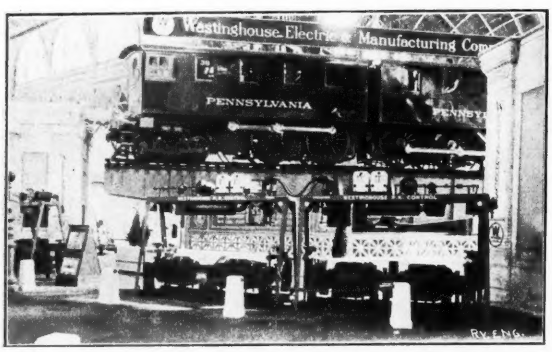
This locomotive, which, owing to its being mounted 12 feet from the floor at the intersection of the two main aisles of this most interesting part of the Exposition, forms a part of the exhibit of the Westinghouse Electric & Manufacturing Comnay.

The locomotive exhibited is one of thirty-three, 4000 h. p. 650-volt D. C. locomotives. They are double unit, used by the Pennsylvania Railroad in hauling trains in and out of the New York Terminal. The locomotive was removed from service only for exhibition purposes. The design and record of operation of this class of locomotive was the cause for the awarding of the highest prize. We recently published a brief account of this class of locomotive.

It is mounted on a turntable that rotates once every two and one-half minutes. The monster of steel seems to have a majestic dignity that never fails to arrest the attention of a visitor.

In order to demonstrate the high contact pressure present in the switches used in (not seen in illustration) Westinghouse unit switch control, one of them is shown, with the side cut away to give a clear view of all the working parts, mounted on a rack and arranged with weights attached to the moving jaws of the switch. It is shown by this arrangement that the spring pressure against which the switch closes and which is available for opening the switch is 65 lbs., and that in addition to closing against this spring pressure, the switch exerts an actual contact pressure of more than 110 lbs.

Around the base of the locomotive are a number of A. C. and D. C. railway motors of various types and capacities, and it is interesting to note that the company was awarded the gold medal on its line of A. C. and D. C.

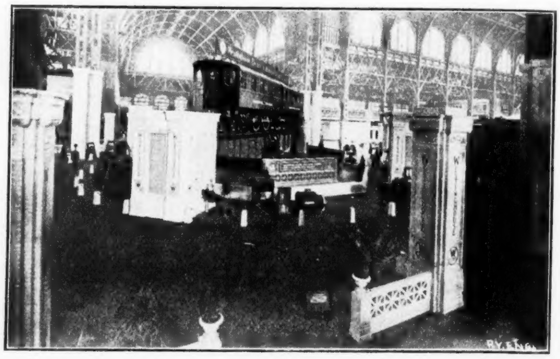


P. R. R. power units on turntable

railway motors, also for its line of A. C. and D. C. generators.

Among the more interesting of the motors shown may be mentioned the pressed steel motor, 36 kw., weighing 2,110 lbs.; the newly developed 5,000-volt direct current motor which has been in successful operation on this and even higher potentials, and the No. 412-A, single-phase, 25-cycle, 220 horse power used in the Philadelphia Paoli electrification of the Pennsylvania Railroad which has just been put into service. There is displayed around the space, a complete line of parts entering into motor construction.

Following out the educational idea of the Exposition, there is a very practical exhibit of armature winding that always attracts those interested in electrical matters, consisting of a No. 306 armature with various sections at different stages of winding from the slot to the completed winding, permitting an inspection to be made of the method of winding, insulating details, building up of coil supports, the extra insulating strips whenever the coils cross to eliminate chafing, the U-shaped pieces where coil leaves the slot, and various other insulating details



Double units in the distance.

employed in the production of Westinghonse motors. By carefully examining this armature one can get an excellent idea of the construction of modern railway apparatus.

Railway lightning arrestors are shown in a very interesting manner with the aid of a 5 kw. transformer supplying 13,000 volts to a set of condensers and two adjustable spark gaps. By means of this apparatus high voltage, high frequency, discharges are created and then dissipated by the arresters in a manner approaching actual service conditions.

All of the exhibits are appropriately grouped around the locomotive as a center piece, each group pertaining to some particular branch of the electrical industry, the whole exhibit having been awarded the gold medal by the jury of awards as being the most attractive and complete exhibit in the Transportation Palace. This exhibit also is the headquarters of the Director of Exhibits, H. W. Cope, who has charge of all the company's interests at the Exposition.

CANADIAN PACIFIC RAILWAY CO.

The report of this great corporation for the year ended June 30 last shows gross earnings of $98,865,209.78, and working expenses of $65,290,582.49; net earnings were $33,574,627.29.

After payment of all charges, including dividends and a contribution to the pension fund, there were left as surplus for the year only $89,914.75. The percentage of operating expenses to gross revenue was 66.04.

Uncontrollable conditions caused an abnormal falling off in gross revenue, and in spite of great reduction in the operating expenses, the net earnings fell off $8,851,300, compared with the results of the previous year.

Even this tremondous falling off did not interfere with the payment of regular dividends. This magnificent property, like others on this side of the Atlantic which have suffered many hardships of late years, will feel the effect of the coming business revival to an unusual extent.

Track Work Programme During the Different Seasons of the Year

By J. Hickey, Michigan Central Railroad, St. Thomas, Ont.

Spring Work—Should begin as soon as the frost is out of the roadbed. The condition of the track where shimmed should have close attention and be closely watched while the frost is coming out, and in order to keep the track in good condition, the thick shims should be replaced by thinner ones as fast as the heaved roadbed settles; this work should be continued until the shims have all been removed from the track.

When the snow has disappeared, each foreman should make a general and thorough search for scrap which has accumulated during the winter frim the different sources, much of which has been covered with snow. This should be carefully sorted and that which is found to be serviceable for use be taken care of, and that which is only fit for scrap, be collected and placed in scrap pile.

As soon as the ground becomes dry enough the work of cleaning up station grounds, yards and right of way should be proceeded with, and the refuse material disposed of to best advantage. Pile up neatly all track and other material in proper places; all refuse material that has accumulated during the winter, including cinders, should be removed from tracks and from around buildings and from company's stock yards.

All switches, leads, and guard rails should be carefully examined and properly secured; many parts may be found to be slightly out of adjustment and may not be readily noticed while being partly covered by snow and ice; close inspection should be made of all foot guard blocking and repairs found necessary promptly made.

The different kinds of work mentioned above, when taken care of at this time of the year, will enable the track force to make much progress when the summer work begins.

Summer Work—It is good practice to hire and take on the summer forces on sections as early as conditions will allow, by so doing a better class of labor can be secured than could be later, as good men are sure to find employment elsewhere. The efficiency obtained from doing work early in the season is to be noted with marked results.

After getting the track first in reasonably good condition for surface and line, the work of tie renewals is begun. The constantly increasing cost of new and suitable crossties, coupled with their growing scarcity, makes it imperative that they be handled with the greatest circumspection and care; to reduce the waste should be encouraged. A matter of great importance in the renewal of ties is to fully determine what ties should be taken out and what ties can safely be left in track for another year. Much can be done during the process of renewal to shorten or lengthen the life of the tie.

Tie tongs should be used instead of picks; if placed heart-side down, the fibres of the timber tend to shed water away from the inner timber. Spike holes should be carefully plugged; a special effort should be made for good results to get tie renewals made as early in the season as possible, by doing so they will have a better bearing in track, and it will be found that track will remain in better condition after being surfaced.

After the work of tie renewals is completed, the work of surfacing track should then be commenced and continued. It is best to begin surfacing at the further end of the section and work towards headquarters. The secret of putting track in good condition that will so remain for a reasonable length of time is one which largely depends on having the men well organized, in getting them to do the work as nearly alike as possible. Foreman when surfacing should test his level board before commencing work every morning, and know that it is accurate.

Ties should be tamped with tamping picks on stone ballast and tamping bars used on other ballast. The ends of the ties and for 18 inches inside of the rail and well under the rail should be thoroughly tamped, and the centre of the tie tamped with shovel blade.

All spikes should be tapped down tight to the rail ahead of the surfacing. This would insure having ties tight to the rail when tamping, and will eliminate creeping of rails. The foreman should see that all joints are full bolted and that bolts are tight as he proceeds with the surfacing. The track surfaced each day should be lined and trimmed and finished.

The work of mowing the right of way should be commenced on or about July 1 or before the weeds go to seed. It depends largely on different climates as to when the work can best be done. After the mowing is completed the material should be burned. When burning is properly done the starting of fires on the right of way and spreading to adjacent property is eliminated. Time is well spent in thoroughly burning over the right of way. Much time is afterwards saved for the men in going to and fighting fires as well as preventing fire claims against the company.

The surfacing of track should, for good results, be completed on or about September 1, so that the men would have an opportunity to go over and carefully examine the track and take care of such spots as may be found out of surface and line. This work properly done will insure track going into winter in good condition and it is reasonable to assume that better track conditions will exist during the winter.

Fall Work—Estimates should be made for the necessary material for repairs and renewals for the next year; rail, ties, switch material, switch timbers, crossing plank, fence material, etc. In making this estimate the condition of the different materials in use should first be carefully and fully examined, particularly ties should have careful inspection. The number of ties for tie renewals at the time of making the estimate should be considered as well as at the time of making renewals; each tie condemned or intended to be taken out of track the next year should be marked. This mark can best be made by an axe or an adze. They should be all marked in about the same place so that other officers who may wish to examine would know where to look and readily find such marks. A matter of great importance in the inspection of ties for renewals is to determine what ties should be condemned, or what ties to be left in track with safety, that would last another year. Several weak ties should not be allowed to remain together in track; decayed ties should not be allowed to remain in curved track; a tie partly decayed in a tangent will sometimes last much longer with safety than on a curve. Thus a tie may be considered safe for

one more year in one place where it would not be so considered in another. This matter is one that should be considered and care should be exercised not to injure good ties when testing for renewals.

Thoroughly good drainage is one of the most essential features of first-class track; ditches should be well constructed and so maintained. Where an open ditch cannot be properly maintained tile should be used; when tile is used, grade stakes should be set in order to obtain the required depth. They should be covered with cinders or other porous material. Branch tiling should be laid at intervals from the main line of tile extending toward the track and be so laid as to be below the track ballast. Tile drains should be used in yards and at all points where necessary for proper drainage of tracks and switches, and be provided with catch basins securely covered with metal grating.

It is important that yards be provided with proper and perfect drainage. The saving in labor and delay to traffic during the winter months in keeping switches and interlockings in working order would soon pay for proper drainage systems.

General cleaning up of station grounds and right of way are in order and all material and scrap should be picked up and placed in proper places assigned for same before snowfall. Snow plow markers should be gotten ready and erected at points where they are required. Snow plows, flangers and other equipment for fighting snow should be put in proper condition as well as the necessary tools, and placed on tracks where they can be readily reached. Snow fences and other means that may be used for the prevention of snow drifting should be erected.

Winter Work—During the winter months the work of putting track to accurate gauge should be done; all ties full spiked; all bolts tightened and all joints full bolted and the necessary repairs made to right of way fences. This work can be done to advantage during the winter months, as there is more or less sod and grass around fence posts which prevents frost from readily entering the ground and preventing such work. This work when done during the winter months will not interfere with the spring and summer's work.

Particular attention should be given to see that ditches are kept open where they get filled with snow, to insure a free passage for water. Other waterways should have proper attention to see that they are not obstructed by ice or other material. Ice should be kept cut from around piling at bridges. It is a good practice to do as much work during the winter months as can be done with economy. The advantage gained is that the track forces will not be reduced to a minimum, and work so done is going to help out with the summer's work.

In the spring the foreman has a certain number of good experienced men to commence his summer's work with. He has done a large amount of work during the winter which leaves him free to carry out his summer's work. He can, therefore, proceed with less men than if he had not done such work during the winter. Another marked advantage in working an additional man during the winter is the fact that a better class of men will be found in the service and the roadmaster will have a much better class of men from which to select foremen. The selection of good foremen is getting to be quite a problem. I feel that this method would be an encouragement to get and hold good men in the service and get efficiency.

We cannot be reminded too often of the necessity of extra precautions for the protection of the travelling public, our fellow workmen and ourselves. Safety of the track is all important, but we must have intelligent safety or safety that is not wasteful either in labor or material.

ON THE CHICAGO & NORTHWESTERN

By Emil Knack, Oshkosh, Wis.

In the spring of the year, which is without doubt the most important period in our line work, the first necessary work will be the tightening of bolts and driving down spikes, which should be started early in March and finished as soon as possible, so that it will not conflict with the more important work to follow. Next comes the removing of shims, which is done as the weather permits. By the time the shims have been removed, the ground has become soft enough to put in ties. Every available minute should now be used for this branch of the work, though, of course, the rest of the track should not be neglected at this time. Any necessary track raising should be done as required. All ties should be in the track by June 1. This may seem reather early, but nevertheless this work should be finished by that time if possible, for the following reasons: The gravel is much easier worked in the spring than in the hot weather; in hot weather a man can harly average more than eight ties per day, while in the earlier season one can average from twelve to fifteen. It is, therefore, advantageous to finish this work by June 1. After this work has been accomplished comes the cutting of weeds. While this is not as important as other branches, the weeds should be cut before they become too thick, which would require more time.

Summer.—Track raising, lining, surfacing and shouldering will take up the remainder of the summer. This work should easily be finished by the latter part of September, and before the usual heavy rains that are due about this time. If raised during the hot weather, while should again be resumed. Track should be gauged, bolts done after the rainy weather is here. It is, therefore, necessary that this work be finished before the latter part of September.

We are now in the fall of the year, and after the main line has been raised, lined, etc., work on side tracks should begin. After side tracks have been repaired—probably some time in November—the work on the main line should again be resumed. Track should be gauged, bolts, tightened and spikes driven down, and preparations made for the cold weather to follow.

With the cold weather comes the heaving of track, which will vary according to the severity of the weather and material of road bed. Of course, the only way to overcome this heaving is by the use of shims.

If all the branches of the work, no matter how important, were started and finished at the proper time, much time and labor would be saved and a better track would be the result.

ON THE SANTA FE

By V. H. Shore.

I have handled section work for the past ten years in Kansas and the program given below is suitable to a place of like climate.

We have, as a rule, a heavy rainfall here in the spring, which sometimes lasts far up into the summer season. There is usually less rainfall in the fall of the year and often much snow in the winter season, commencing in December and lasting until the middle of March. The snow is usually accompanied by a high wind and the cuts fill up and often cause serious delay to traffic. Our country is generally quite level and we do not have trouble with washouts.

Spring Work—Ties should be distributed for the spring work during the winter and as soon as the frost is out of the ground I start at the further end of my section and pick up the bad places in the track clear to the other end, inserting new ties where I find bad ones

in the spots that I am working on. At the same time we inspect all waterways and see that they are opened up so as to be ready for the spring rain. We then start from the farther end of the section again and pick up all the small low spots, inserting the remainder of the new ties and raising the track out of face where necessary, also lining the track as we go.

Where track is raised out of face I put up enough for the day's work, tamping ends only, and where not more than one tie comes out in a place I leave it until the centers are all tamped and then insert the new ties. They are inserted at a very small expense in this way.

Where track is in good surface and line, the ties may be renewed at a less cost by raising three or four spikes each side of the old ties to come out and then raising the rail a little bit so as to let the tie slip out. A little dirt or ballast should be removed from one side of the old tie before trying to pull it out. Raising the spikes will prevent the track from raising the ties off their beds. If the new tie is about the same thickness as the old it should be slipped in on the old bed to save tamping. If it is larger the tie bed should be hewed down to the same depth of the tie that is to replace it.

I always try to select a tie for renewal which is as near the thickness as the one coming out as possible to find and I also pay a good deal of attention to the spacing between ties and try to improve this if I can.

Up to the first or middle of May we do this kind of work exclusively, pushing it as hard as possible, and then turn our attention to the weed problem. I start at the farther end of the section and clean up the weeds running through to the opposite end. By commencing on them before they get large, a small gang of men can cut the entire section in a short time. We then return to tie renewals and spotting up track where we left off and can easily get from three weeks to 30 days work in again before the weeds have to be cut the second time. The section foreman must not let the weeds get the start of him or he will not be able to accomplish much during the remainder of the year.

Summer Work—The work in the summer time is a continuation of that in the spring, but more time must be put in on weeding. Of course the latter part of June or the first part of July there are the additional duties of protecting the wheat fields from fire. We have considerable June grass that matures and dries up about the middle of the month. This usually grows in patches and necessitates shovel-cutting a guard next to the right of way fence to keep down the danger of fire to wheat fields. As soon as the wheat is cut the foreman must have guards plowed through the fields a safe distance from the track (say about 250 ft.) to protect the wheat stacks. He must also shovel cut across public highways at the end of these guards and connect them up. When impossible to get guards plowed he must shovel-cut them. I usually employ someone to plow these guards long before it is necessary, paying the teams harvest wages. In some localities we can get the farmers to plow the guards in exchange for the old ties that come out along their farms, but all roads will not permit this. As soon as the wheat fields are made safe we return to our track work.

All crossings should now be put in good shape as the threshing season is on and the farmers will want to use them hauling wheat to their bins and putting it on the market. If the crossings are kept in good condition this will take but a few days and it is one of the details I take care of while renewing ties and surfacing.

During the summer season I mow one good swath at the edge of the weed line with scythes, doing this often enough to keep the weeds down. This can be done at the same time the weeds are being cut down with the shovel in track. On dirt track we cut the weeds to about 2 ft. outside of the ends of the ties, on rock ballast about 20 in. from the toe of the ballast and mow the remainder of the shoulder, as it protects the berm from blowing and washing away. The weeds should be thrown on the shoulder and left there because there is some dirt with them which must be thrown back into the middle of the ties. Also the dirt on the shoulder is likely to be blown or washed away and the weeds help fill up the trench which would otherwise be formed.

I find the scuffle hoe the best for cutting weeds because a man can stand straight as he works. A hoe will also go between the ties much better than a shovel. On rock ballast I cut along the toe line with the hoe, being careful not to disturb the edge of the ballast, and pull the weeds by hand that grow in the toe line and on the slope of the ballast.

Fall Work—The first thing to do in the fall is to finish spotting up the track and insert the remainder of the ties, but this work should take but a very short time. The next thing to do is to make fire guards through the meadows, pastures and feed patches and burn the right of way. This should be done as soon as the grass will burn. If the right of way is mowed with a machine, this should be done at the end of the summer season or beginning of the fall and the right of way burned as soon as the weeds dry up sufficiently to burn. The next thing to do is to get after the ditching and open up the waterways before winter so that the water melting from snow can quickly escape from getting near the track.

At this season of the year all bolts should be tightened as if this is left until colder weather many will be broken. Temperatures ranging from forty to seventy degrees are favorable for bolt tightening. I carry this work through, beginning at the further end of the section and working toward home, and do likewise with ditching and fencing. The fences are next put in good repair, the material being on hand ready for the job.

Winter Work—The track should now be in good riding condition, the ties all in and the screws will probably have been reduced to a winter basis. Switches and sidings should be repaired, paying especial attention to the gage and dirt and ballast cleaned from under connecting rods and tie rods in switches so that they may move freely and not become frozen up by freezing and thawing.

In cases of heavy snow my first attention is given to sweeping switches, keeping points and spring rail frogs clear of snow, so that when the switches are thrown for trains, points are not damaged from being full of snow and becoming sprung. As soon as the storm is over and there is danger of a thaw the cuts should be looked after, the snow removed from the mouth to prevent them becoming blocked. In long cuts I make a ditch in the snow about 2 ft. wide near the back of cut to facilitate drawing the water away. The track is patrolled daily, looking for broken rails, cattle guards crossings, fences, wires, switches, etc.

When allowances are too small to carry out this program I put one end of my section up one year and complete it the next, giving the entire section an overhauling every two or three years, repairing everything that would be likely to get bad on the part that was put in the previous year.

Whenever going over the section the large pieces of scrap which are seen are picked up and taken to the tool house preparatory to loading them up in scrap car which comes around once a month. Once a month the scrap is picked up thoroughly, commencing at the further end of the section and working toward the other, and all rubbish is burned or buried. Station grounds are cleaned up twice a week.

THE FREIGHT TERMINAL

The terminals of a large railroad may be likened to an immense stomach in which the process of digestion is always going on. As in digestion there are many processes progressing at the same time, but with a single purpose in view. Such in effect was the way Mr. C. M. Himmelberger, superintendent of the Raritan River Railroad, led his hearers at a recent meeting of the New York Railroad Club to the contemplation of a subject which is seldom touched on by club speakers or railroad men in general.

The proper operation of a freight terminal has become a very important part of railway service. In view of the complex nature of its operation it might almost be said that it is far more important in its relation to the prompt handling of traffic than actual road service or train movement. Successful operation depends principally upon a well-planned track layout. The operating officers may possess every qualification, but if the design of the yard is such as to prevent the free and uninterrupted movement of the traffic dissatisfaction must result. It has been a moot question whether a large number of independent terminals in a given locality should be concentrated and operated as a consolidated unit, or whether better results may be obtained by operating the independent terminals as separate units.

In a freight terminal of large proportions, ample ground space, if available, should be utilized for the layout, so that traffic will move in the line of least resistance, with no cross currents of traffic. The real measure of value to determine the efficiency of yard operations is to provide for the handling of the greatest number of cars per hour or per day. In order that this may be accomplished, a yard engine should not suffer any interference during the course of its day's work. The leads to the yards that it serves should be entirely independent of leads to other yards, and the work done should be free and uninterrupted. Idle motive power and train crews are very expensive and their idleness is a distinct economic waste. As long as an engine is moving in the direction of its final destination, it is earning revenue, but whenever standing idle or when retracing its course, in order to reach its destination, the engine and crew become expensive and extravagant for their road.

Another important feature of a terminal layout is to provide proper and sufficient electric light throughout the yard. It is difficult to do this in old yards, but in a new yard the consideration of this important element should not be neglected. The cardinal principle, therefore, upon which the ideal terminal operation depends, is to so design the various yard sections of the terminal as to introduce the minimum amount of interference between the operations in adjacent sections of the yard. Upon this successful terminal operations depend, in order that cars may be distributed from the general receiving yard to the different piers, float bridges, warehouses, local delivery or truck tracks, freight house sidings, coal piers, etc. It is a fallacy to suppose that any old piece of machinery that was once called a locomotive will answer as a drill engine. In these days of efficiency in operation, the best results can only be obtained from the employment of power sufficiently heavy and kept in first-class condition to meet the requirements of the yard where it works. Each yard is in itself a separate problem. No two terminal yards are ever exactly alike. The conditions that such layouts create must be met and solved.

In dealing with subordinates, or with representatives of shippers, consignees, and others with whom he must come in daily contact, the General Yard Master should have the full support of the Superintendent and Train Master. The Terminal Train Master, the General Yard Master, and the Freight Agent should, from time to time, hold joint staff meetings, at which there should be representatives of all classes of assistants in charge of the distribution of traffic. At these meetings a general exchange of ideas, differences of opinion, and adjustments of questions can be talked over, conditions regulated, so that the men become more thoroughly acquainted with each other's territory. It has also been found to be advisable to include certain of the yard clerical force in these meetings. Too much emphasis cannot be laid upon the good to be derived from staff meetings; numerous questions of mutual interest covering improved methods of terminal operation are constantly arising.

It may not be amiss to say that the quick and successful operation of the Terminal depends to a large extent upon the ability of the office force to furnish information at a moment's notice regarding the location of cars, and to know the time necessary to place cars promptly at industrial plants, piers and docks for outgoing steamers, etc. Another important factor is close contact and co-operation with the Car Distributor, Chief Dispatcher, General Yard Master and the Terminal Train Master. Ample telephone facilities should be provided throughout the yard. This not only makes the service more satisfactory to those outside of the detailed operations of the yard, who must communicate with officials and clerks, but it also facilitates the business between those offices which find it necessary to constantly speak to one another. The close association of the Car Distributor with the Chief Dispatcher's office will enable him to quickly distribute cars throughout the different arteries leading out of the terminal district.

A careful study of officers of the character, personality, ability for organization, and control of men under their immediate command, is necessary. The thought should be kept in mind that "A chain is no stronger than its weakest link." Another axiom may be stated thus, do not place weak men in charge of the important points, nor send men of marked ability to unimportant districts. And, finally, make co-operation and team work the keynote. This, supplemented by economical methods and up-to-date facilities and equipment, will produce gratifying results.

THE CUBA RAILROAD COMPANY

The report of this company for the year ended June 30, 1915, shows gross earnings of $5,206,714.15, as compared with $5,164,670.84 for the preceding year. The net earnings amounted to $2,727,539.85, as against $2,470,921.75, an increase of $256,618.10—something more than 10 per cent. The proportion of working expenses to gross earnings was 47.61 per cent as compared with 52.16 per cent in 1914. Two half yearly dividends of 3 per cent have been declared on the common stock of the company, one of which was paid May 1st last, and the other is payable on November 1st next.

The report generally should be highly satisfactory to its stockholders. This property, of which the late Sir William Van Horne was president, represents an instance of close attention and care in railroad management. The railway, as shown by this report, seems to have been well maintained and its equipment and appurtenances are in excellent condition. The mileage of this railway all told is 602. It has 103 locomotives, 160 passenger cars and 2873 freight cars. It also owns one steamship, 4 steam tugs, 7 lighters and one dredge. The system covers practically the whole Island of Cuba, which is steadily growing to be a great country.

The Theory and Causes of Rail Creeping

By Paul M. LaBach, Asst. Engr. Rock Island Lines

The creeping of rail has become a question of considerable importance to those who are responsible for the maintenance of track. The best evidence of this lies in the fact that a good deal of money is being spent for a variety of appliances which hope to provide a cure. The term "creeping of rail" is used to describe the movement of the rail in the direction of the longitudinal axis of the track. A properly built track will not creep if no trains run over it when due allowance is made for expansion. However, it sometimes happens that when rails are driven together the expansion due to temperature changes, they will cause what are generally called "sun kinks." Curves will move out of line and other troubles occur. The proximate cause is the creeping of the rail which took place at some previous time or the cold rolling of the rail head closing the expansion gap between the rail ends.

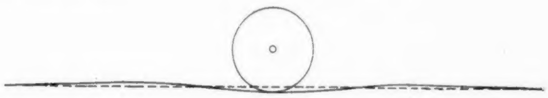


Fig. 1

A great many subdivisions may be made but, generally speaking, creeping will be found to come under six heads: (1) Creeping due to locked wheels; (2) creeping due to the tractive power of the locomotive; (3) creeping due to the wave motion in the track produced by the rolling load; (4) creeping due to the lack of continuity of the rail; (5) creeping due to the nosing of the locomotive; (6) creeping due to the coning of the wheels.

Creeping Due to Locked Wheels.

When wheels become locked through the action of the brakes, the wheel slides or skids along the rail. This

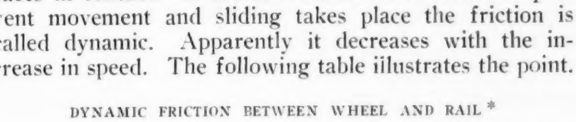


Fig. 2

causes flat spots on the wheel and injures the rail. When the limiting friction between two bodies is enough to prevent the movement of the bodies the friction is called static. It naturally depends for its value upon the surfaces in contact. If the friction is not sufficient to prevent movement and sliding takes place the friction is called dynamic. Apparently it decreases with the increase in speed. The following table illustrates the point.

DYNAMIC FRICTION BETWEEN WHEEL AND RAIL *

Speed of Train.	*Coefficient of Friction.*
Just coming to rest.	0.242
6.8 M.P.H.,	0.088
13.6 " ..	0.072
27.3 "	0.070
34.1 "	0.065
40.9 "	0.057
47.7 "	0.040
54.5 "	0.038

This means that when the wheel is rolling without sliding that the resistance to sliding will be more than 0.242 times its weight. But if sliding commences the resistance to this movement at 54.5 m.p.h. will be 0.038 times its weight. This friction increases and also decreases with the speed. When the brakes are applied the relative motion of the wheel and brake shoe are decreased until such a point is reached that the dynamic

Fig. 3

friction becomes static and the wheel becomes locked and skids along the rail until the dynamic friction of wheel and rail is increased and is changed to static and the car stops. The only way this can happen is for the friction of the brake shoe to be greater than the static friction of the rail. We frequently see cases of this when the drivers of a locomotive spin. As they slow down they begin to take hold and finally roll instead of slide. When trains are brought to a stop there is frequently sliding between wheel and rail when brakes are applied too suddenly. We would expect it to be greatest as speeds decrease and to reach a maximum as the car stops. Creeping due to this sliding is sometimes found at stations and is in the direction of running.

Creeping Due to Tractive Power of the Locomotive

If the rail were mounted on frictionless rollers and an engine consisting of drivers only were mounted upon it, the starting of the drivers would move the rail backwards and the locomotive would not go forward at all. This situation of course is never found. The load on the rail causes friction between the rail and its support of sufficient magnitude to prevent movement in ordinary cases. Also the load which is being hauled would prevent any movement in the rails under the train. Where all the axles are drivers, creeping due to this cause is sometimes found. The tractive power of the steam locomotive decreases with the increase in speed, so creeping due to this cause would be found at starting points if anywhere and would be opposite to the direction of running.

Creeping Due to Wave Motion

One of the first writers to advance the theory that wave motion was the cause of creeping was Prof. John-

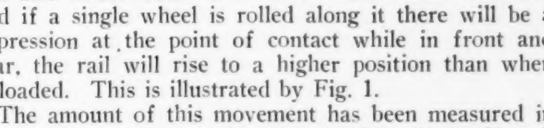


Fig. 4

son. He compared the movement of a rail to that of an oscillating fluid. Liquids do creep, but the height of the wave in proportion to its length is greater than with the rail and wheel load. The track is an elastic structure, and if a single wheel is rolled along it there will be a depression at the point of contact while in front and rear, the rail will rise to a higher position than when unloaded. This is illustrated by Fig. 1.

The amount of this movement has been measured in this country and abroad and several books in French

* Henderson Locomotive Operation, page 204.

and German have been devoted to the elucidation of the subject. Dr. P. H. Dudley has published a number of monographs dealing with stresses in track which have a bearing on the compressibility of the track. At the present time the American Society of Civil Engineers and the American Railway Engineering Association have a joint committee on stresses in track, which committee is making numerous tests. As the latter has not published its results I am compelled to refer the reader to tests made some years ago. The principles involved are the same but the measurements may differ from those we might find in our own tracks at the present time.

The following is taken from tests made by Mr. Couard in France:*

"When the first wheel of the engine is at 6 metres (19.68 ft.) the movement of the cross-ties from low to high begins. When the first wheel of the engine is at 3 metres (9.84 ft.) the displacement is maximum. When the first wheel of the engine is at 2 metres (6.56 ft.) the movement from high to low, below the initial line begins. When the wheel is above the cross-tie the depression of the cross-tie reaches its maximum." The above figures are only averages. The movement is further illustrated by Fig. 2.

The reader will note that there is negative or upward bending between the two wheels. A diagram showing the bending moments is shown in Fig. 3.

This rise and fall is found under and between each pair of wheels. The only question is as to whether waves so small in depth and comparatively long span can produce creeping.

Dr. H. Zimmermann, the well-known German engineer, has undertaken to find out mathematically what the amount of the force might be. His demonstration is too long to quote in its entirety. His conclusion will be understood by referring to Fig. 5.

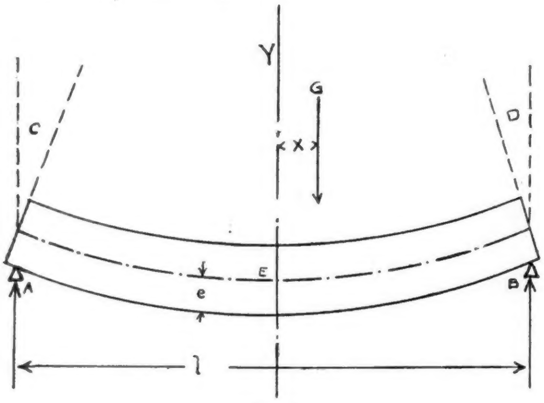


Fig. 5

G = Wheel load.
I = Moment of inertia of the rail.
E = Coefficient of elasticity of the rail.
x = Distance of load from axis Y passing through the centre of span.

The load being a rolling one it will increase at any point from zero to G, and as it advances the lower side of the rail will increase in length over the upper one.

The total sliding may be expressed by the following formula:

$$W = (x + D)\,e = \frac{Ge}{2EI}\,(l^2 - x^2).$$

It will only occur where the least resistance has to be overcome. In the figure shown this would be at A as it has the smaller reaction and therefore the least friction. If the load starts at A it will be noted that for a part of the time the slipping will be at B. The maximum value will be

$$W = \frac{Gel^2}{2EI}$$

When x = o.

As the load continues to advance, beyond the centre, the slip is at A and the left end of the beam begins to move toward the right.

It will be seen that during the movement of the load from left to right that the beam will move also in the

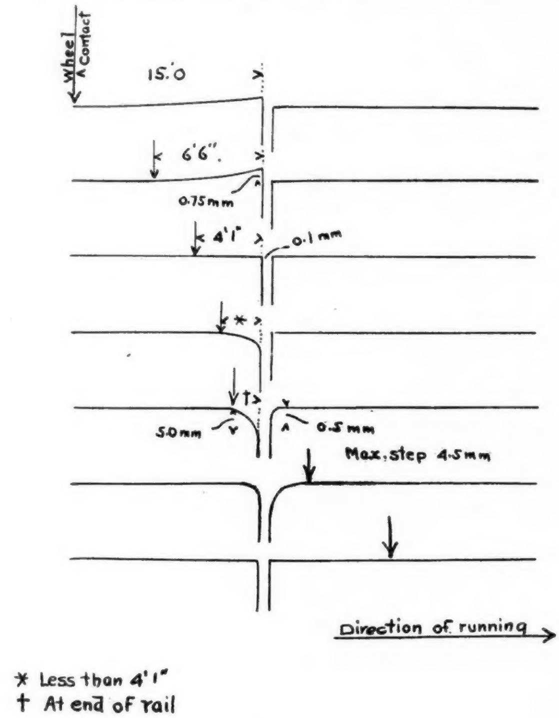


Fig. 6

same direction. Dr. Zimmermann represents the work of friction due to this movement when a beam is supported at two points by

$$A_1 = \frac{G^2el^2f}{GEI}.$$

For a beam secured at one end

$$A_2 = \frac{G^2el^2f}{2EI}.$$

Where G = Rolling load; f = Coefficient of friction of rail or beam on its supports; l = Distance apart of the supports; E = Modulus of elasticity of the steel; I = Moment of inertia of the rail section; e = Distance of neutral fibre from outer fibre.

From the last two formulas we get

$$A_2 = GWf.$$

If we let P equal the mean force which on the track W performs the work, A equals,

$$PW = GWf$$
$$\therefore \quad P = Gf.$$

That is, the force which pushes the rails longitudinally

*Deformation of Railroad Tracks, etc., by G. Cuénot. Translated by W. C. Cushing, Chr. Engr. M. of W. Penna. Lines S. W.

is nearly equal to the friction of the wheel on the rail. The following example will illustrate:

Let $G = 30{,}000$ lbs.; $e = 3.0$ ins.; $I = 39.0$ ins. fourth; $E = 30{,}000{,}000$; $l = 20.0$ ins.; $f = 0.15$,

$$W = \frac{30{,}000 \times 3.0 \times 20 \times 20}{2 \times 30{,}000{,}000 \times 39} = - \text{ inch, sliding.}$$

$A_2 = GWf = 69.24$ inch-pounds of work.
$30{,}000 \times 0.15 = 4{,}500$ lbs. reaction due to the work.

The sliding of the rail is prevented by its attachments and the butting of the rail themselves. When these are insufficient or the next rail is undergoing like changes the creeping takes place. The general deductions that may be made from the foregoing are that creping due to wave motion will increase directly as the load, inversely as the stiffness of the track and directly as the square of the tie spacing. Another way of stating that is that the creeping due to wave motion will increase with the speed, the traffic and the stresses in the rail.

Creeping Due to the Lack of Continuity of the Rail

The joint being the weakest point in the rail has attracted a great deal of interest among engineers, track-

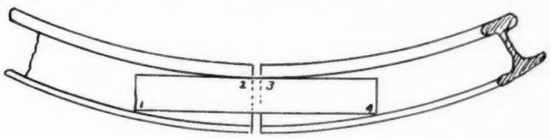


Fig. 7

men and laymen. Patents innumerable have been issued which are more notable for their ingenuity than for their practical worth. In the technical journals of Europe will be found reports of numerous tests of angle bars or other joint fixtures. Four of these investigators are Zimmermann in Germany, Cuènot in France, Ast in Austria and Wasiutynski in Poland.* Without going into the details of their experiments it is only necessary to say that the joint fixture, while it checks, does not alter the characteristic movement of two rails without fishing. While continuity is apparently achieved by the new fixture in a short time, there will be lost motion, and the same action will be there as is found in disconnected rails, only of lesser amount. Mr. Ast in his tests found the results shown in Fig. 6. The rails are disconnected.

The steps shown in these figures are found when there is wear at the rail gap and at the lower corners of the bar. It is the natural result of the bending as is shown in Fig. 7. At the present time there are no available reports to show just how much the step amounts to, but it is frequently more than the average person appreciates. Rails are not exactly the same height, as specifications allow 1/32 in. over and 1/64 in. under the exact sizes. If the step was 1/64 in., due to play in the joint, the total step might be $1/32 + 1/64 + 1/64$, or 1/16 of an inch. The amount is frequently much greater than that, but this will be used in the following illustrative computation:

The velocity of the 33-in. wheel is assumed as being 30 m.p.h., or 44 ft. per sec. The average load of a freight car wheel in western territory is 17,000 lbs. A 1-16 in. step would be 1.437 ins. ahead of the point of contact of the wheel and rail. The centre of the wheel would move through this space in 1-367 second. It has been demonstrated in works on mechanics that Force $\times$ Time equals Mass acted on by the force $\times$ the change in its velocity during the time the force acts. The velocity is determined from the angle $\emptyset$ in the figure. This is sine

$$-1 \frac{0.7185}{16.5} = 0.04\ 356.$$

The vertical component is found by multiplying the horizontal by $+$ an $\emptyset$. This gives 44×0.0455 equals 1.917 ft. per sec. The wheel attains this velocity in the time necessary to move 0.7185 ins., or 1/735 sec.

$$F \times \frac{1}{735} = \frac{17000}{32.2} \times 1.917$$

F, the vertical component of the force necessary to raise the wheel over the obstruction in the given time, equals 743,900 lbs. The horizontal component will be 64,800 lbs. if we assume that the force acts normal to the surface of the wheel.

It is apparent that the force driving the rails in the direction of running is considerable. It will decrease as the ends of the rails are rounded off. This will usually take place before the rail joint becomes worn. The first wheel of the pilot would produce the greatest disturbance in proportion to its weight, as there are no loads ahead of it to hold the rail in position.

Creeping Due to the Nosing of the Locomotive

If for any reason the nosing is any greater on one rail than on the other, greater creeping would be expected. The movement of the engine produces waves in the horizontal as well as in the vertical plane. Anything which would increase these waves would increase the creeping. It sometimes happens that when one crank leads, greater nosing is found on the opposite rail. For instance, when the left crank leads, other things being equal, greater creeping would be expected of the right-hand rail.

Creeping Due to Coning of the Wheels

An interesting article has been written by a German engineer named Kruger (called Organ fur die fortschritte des Eisenbahnwesen, 1886), in which he shows that a cone revolving on a canted rail would produce creeping. In America, as yet, we do not cant the rails, so this demonstration does not fit our case. However, the force would be inconsiderable, as it only amounts to 0.3 of a lb. per 1,000 lbs.

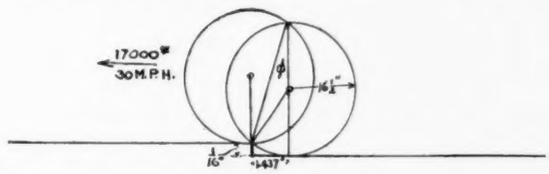


Fig. 8

Most of the cases of creeping which have been observed can be accounted for when analyzed with the foregoing in mind. Rails creep down hill on single track usually because the trains run faster and the dynamic forces are greater. The outside rails on double track sometimes creep faster than the inside ones; this is due to the fact that the shoulder of the roadbed is softer than the centre and greater wave motion is produced. On curves, both the outer and inner rails have been found to creep faster than those opposite. The dynamic forces are sometimes greater on the outer rail than on the inner;

*See Computation of Stresses in Angle Bars by P. M. LaBach. Proceedings of the Amer. Ry. Engineering Assn., Vol. 16.

the reverse is also true at times. It largely depends upon the question as to whether the trains are running faster or slower than the speed for which the track is superelevated. When they run slower, the greater load is generally carried by the lower rail.

The conclusion we can draw from the foregoing is that worn fixtures and low joints are the chief causes of creeping. The secondary cause would be wave motion, due to flexibility of track or roadbed. The latter in extreme cases might be the primary cause, but as the two are apt to be present at the same time, it would be hard to distinguish between them. There are special cases, as at the Eads bridge, where locked wheels might be the primary cause. The remedy lies in having track commensurate with the loads carried, and maintaining it so that there is a minimum amount of hammering at the joints.

RAIL SPECIFICATIONS AND FAILURES

An address given a short time ago by Mr. A. W. Gibbs, chief mechanical engineer of the Pennsylvania Railroad, at the annual convention of the American Society for Testing Materials, of which society he was president, has been called the "Steel Rail Puzzle," although the address was on the subject of "Our Rail Specifications." He said among other things, We, as a nation, cannot get transportation for less than it costs. How shall this "commodity" be manufactured and sold at a price that will make investment desirable?

The public objects to pay more and practically controls prices by legislative enactment. Taxes have become heavier, elimination of grade crossings are costly, substitution of steel for wooden passenger cars takes money, new terminals, etc., produce little revenue, employes' wages have constantly to be raised, and all these threaten to wipe out the margin of profit.

The answer to this in the United States is, heavier loads and more of them. This leads directly to the rail problem. The annual crop of rail failures, compared with the total number of rails in service is very small, when reduced to percentage. The enormous preponderence of those laid are removed because they are worn out. It is because the rail is part of a chain that its occasional failure assumes such importance. The real answer to this great problem of rail failures has not been found, is evidenced by the changes constantly made in specifications and rail sections.

As users we can lessen unnecessary punishment of the rail by improvements in the mechanical design and maintenance of equipment. We may be expected to improve the structure under the rail as loads increase, and this change is in progress. Bad conditions in track structure and equipment have contributed to rail failures. These unsatisfactory conditions exist, but there are several possible remedies, viz.: better steel, that is, more uniform; better steel with more rational sections; materially heavier sections or retrogression in loads and speed. Up to the present a combination of the first two has resulted in a very general change to open-hearth steel at an increased cost.

The American Society for Testing Materials has had four revisions of specifications in eight years. The present specification is almost identical with that of the American Railway Engineering Association, but the seemingly small differences are important. Both are alike in the chemical requirements. Both provide that the analysis of the drilling shall be taken from the ladle test ingot. Both ignore the fact that the chemical constitution of the rails, at least in a number of cases, is apt to differ widely from the ladle analysis. In the case of open-hearth steel, the specifications require an analysis for each heat. In Bessemer steel rails, the constituents, other than carbon, are averaged for two complete analysis for each twenty-four hours, to determine the quality. It is difficult to see how a specification could be made more absurd.

From the physical standpoint both specifications are defective. Both contain the provision that if the test piece meets the requirements, the material shall be accepted, but in the event of the failure of the first test piece, two more tests are made, and if both pass, the material is accepted. The speaker stated that he believed this to be a pernicious practice, because the consumer has positive proof that some of the accepted material does not meet requirements.

The American Society for Testing Materials includes in its specification all the machinery for detecting physically unsound material, and yet allows rails so found to be defective, to be accepted as "Specials." Presumably these are to be used in some unimportant locations. This is very bad practice, as one cannot always find unimportant locations; and designating by paint or punch marks become illegible. The only way to keep such defective material out of important service is not to ship it from the mill.

The Testing Society specification does not put a premium on the selection of the better part of the ingot for use in one of the most exacting pieces of service for which steel is used. If year after year there are retained in the specifications of the Testing Society provisions that lessen the incentive to improve the product, other specifications will be preferred.

Post mortem investigations on rail failures are not always reliable. The rail may have been damaged by unfair usage, of which there is no evidence. If due to defective support, the evidence is lost when the track is repaired. Damage from defective wheels leaves no permanent mark. Many believe that the straightening press, by straining the material beyond the elastic limit, is responsible for many unexplained failures, and this would explain why rails from the lower part of the ingot figure so prominently in the breakage record.

Nearly all rails pass through the gagging press. The rail specifications are possibly too exacting when they require "smooth, straight in line and surface, and without any twists, waves or kinks." A possible tollerance of such variations from straightness, as can be reasonably eliminated in laying, should be considered.

The rail situation, Mr. Gibbs believes, is on the whole, disappointing. The American Society for Testing Materials has, as one of its functions, the prescribing of specifications and tests, which if enforced will prevent improper material from getting into service. This calls for constructive work in committee. It has been done with other products, why not with rails?

Announcement is made by the Southern Railway that the modern export coal handling plant which has just been completed at Charleston was put in operation for the handling of commercial coal last month, giving Charleston facilities the equal of any on the Atlantic seaboard for handling coal to be borne over seas, and providing another export outlet which will be of particular value to the coal producing territory served by this railway and immediate connections. The terminal will have a capacity of forty cars and two thousand tons per hour, which is as fast as any ship now in the coal-carrying trade can take it. It is operated entirely by electricity, and will deliver coal into the holds of ships with a minimum of breakage by means of an electric conveyor.

Inclining the Rails

EDITOR, RAILWAY ENGINEERING,

Sir.—In regard to your editorial on the inclination of rails in the August issue of RAILWAY ENGINEERING AND MAINTENANCE OF WAY. There is no question in my mind any longer that this is the proper thing to do.

I have installed a section of track about two miles long on the Lond Island Railroad, with inclined tie-plates and I find that we are getting elegant results from the rail wear and the riding of the track, and more particularly on curves.

E. M. WEAVER,
Engineer Maintenance of Way, L. I. R. R.
Jamaica, N. Y.

EDITOR, RAILWAY ENGINEERING,

Sir.—Relative to your editorial entitled "Inclining the Rails" and also the article concerning the tie plate, in the August issue of RAILWAY ENGINEERING.

From an entirely theoretical standpoint, one must readily concur in the views you have expressed, that the inclining of the rail with the bevel tie plate would be more scientific than the present practice; but looking at the matter from the practical side, it appears that there is considerable question as to whether the result obtained would justify the supposedly additional cost.

As is well known, the outer rails on curves are given variable super-elevations to overcome the centrifugal force, the slip of the wheels and the parallelism of the axles. Theoretically, then, the coning of the wheels is supposed to be the means of overcoming the "slip," but this seems to be largely theoretical and only approximately true with ideal conditions of track and equipment.

The real cause of wear on the outside rail is due to the centrifugal force, and we would, of course, still have this force with the resultant wear between flange and rail even though the coned tread of the wheel superimposed itself perfectly upon the entire transverse surface of the outer rail. The change from vertical rail on straight track to inclined rail on curves could not, of course, be abrupt and this means that the gradual transition necessary would increase the cost of maintenance to such an extent that the advantage gained would be more than offset by the increased expense.

R. W. LEBARON,
Engineer Examiner of Joint Facilities.
Chicago Great Western Railroad Company.
Chicago, Ill.

EDITOR, RAILWAY ENGINEERING,

I am in favor of rail being inclined inward both outside and inside of curve. Yet I am not in favor of canting rail by beveling ties with adzes and canting rail inward without tie plates or with tie plates by putting new ties in track you would have to bevel new ties, or else flange of rail will extend above shoulder of tie-plate, and would lessen its strength of holding track to proper gauge. I noted such were the results on a 4 deg. curve on last section I was foreman on, in California, and gauge would spread very rapidly.

I will also make known that I've noticed on one road where I was employed as section foreman the company had a flat tie-plate about 8½ in. square. This tie-plate is one-half inch wider on the outside of rail than on the inside to offset the tendency of the rail to roll outward. In the above cases I noticed it was a complete failure as the traffic caused the tie-plate to cut into the tie on inside of rail and rail turning inward closed the gauge. The writer still remains under the impression that the rail should be tapered by rolling mills for straight track as well as for curves, giving the rails the true contour of the wheel tread. In this manner the load would rest on center of rail preventing rails from rolling outward and would cause less rail failure. The strain of the traffic over the present shaped rails used causes great trouble on straight track as well as on curves, even if tie-plates are used, especially on mountain grades when there is slow speed, there it proves a matter of much more difficulty.

I do not believe that the present shaped rails can be successfully canted to the standard angle of the coming of the wheel. The rail head should conform to that of the wheel, having the same true contour as the wheel has, in order to keep from decreasing the life of both wheel and rail.

I fully believe that the canting of rails has but very little to recommend it in practice on any railway, as I fully believe 95 per cent of the wheels are more or less worn, on account of the wheel and rail having the standard angle in favor of each other. The wheel and rail should have a true contour to last equally in life of both, and we would have no more rails rolling outward, as well all have experienced during the past.

Now let us go into details about the present rails rolling outward on straight track as well as on curves. On curves, by adzing ties, as explained before, there is a natural tendency for rail to roll outward again, after a limited time, and the rail would have to be reset again. Now before resetting this rail again on outside curve, let us consider that the swing of the trains has worn the rail to the shape of the wheel, and it should be realized by every section foreman and by all maintenance officers that after the rail has the same shape of the wheel, it would be dangerous to reset the rail again, because the downward and outward pressure after the ball of the rail has been worn to the shape of the wheel. This would cause derailment from the slightest defect in the track. It would cause the flange to climb the rail and would remain hidden to the board of inquiry, the reason of the derailment.

Properly it would be blamed on rough track, uneven loads, excessive speed etc. Laying new rails as quickly as possible will be the safest, the best and the cheapest course. Any trackman readily understands when new rails have been laid, the rails fit snuggly against the flange of the wheel on outside of curve and there is no more danger and taking chances in having derailments until the rail changes its position again relative to its wheel.

Now about straight track, when track becomes a little rough even if one rides over it fairly well, the gauge will soon spread and at last there will be no alignment. After examining you will find the outside flange of the rail has pressed the tie-plate into tie and caused rail to roll outward, it then needs the necessary attention as usual, adze ties and turn rail to its proper position again and gauge the track. Where there are no tie-plates used, it remains much more of a difficulty.

HENRY KOCH,
Section Foreman, E. P. & S. W. Ry.,
Los Tauss, N. M.

TYPICAL EXAMPLE OF GOOD TRACK

The scene depicted in our illustration is on the Electric Division of the New York Central Railroad south of Yonkers on the shore of the Hudson River. It shows six tracks, rock ballast, electric transmission wires, third rail and electric automatic signals. It is a type of track as nearly perfect as human ingenuity or the N. Y. C. can make it.

The standard adopted by the New York Central Lines for track construction, of which this is a sample, provides for rock ballast, creosoted ties laid 3,300 to the mile and steel rails weighing 105 lbs. to the yard. The mile, or about 19 ins. between centers of two adjacent ties, and steel rails weighing 105 lbs. to the yard. The

Smooth, level, straight stretch of track. New York Central Lines

train shown in this picture is 20th Century Limited on the first "leg" of its run to Chicago.

Some time ago this railroad won the Harriman medal for track maintenance and this little glimpse of the road shows the high class of equipment used and the kind of track.

IS SECTION LABOR SKILLED LABOR?

By N. G. Near.

I say it is to a considerable degree, for I was once a section hand myself. I was strong—20 years old; weighed 170 lbs., and a college athlete. I was more nimble than the other men. I was just as strong, capable of doing work that would pay me more money, but I was not as skillful as the other men by any means. I was not worth as much to the railroad company at that kind of work because I was unskilled.

I couldn't handle a scythe properly at cutting grass along the road bed. The regular hands laughed at me because I could do only half as much work as they could and the result of my labor was remarkably rough. I never did learn how to correctly handle the scythe.

I couldn't drive spikes. I tried conscientiously enough, but instead of hitting the spike every time I usually hit the rail, battering it badly. I could not "swing" the spike maul properly. The only way I could drive spikes was by taking short strokes from the waist down. Time and again I have seen regular laborers drive spikes with the "pointed end" of the spike maul, which has a diameter of only five-eighths of an inch or thereabouts. And these laborers take a full, free swing with all the recklessness and abandon of a Ty Cobb at the bat. I'll wager Ty couldn't drive spikes, and his salary is, let's see, how many thousands?

Tamping ties is not easy either. It is difficult to pack the "just right" amount of soil beneath the tie.

Drilling holes in rails, tightening bolts, laying rails, laying switches, skimming, lining up, and even pcking up wrecks call for something better than common labor. Skill that is not easily acquired is needed in all of these feats.

All roadmasters, section foremen and other upper men recognize the need of experience in a good section hand, yet that branch of labor is seldom credited with being skillful. Why?

FREIGHT TERMINAL

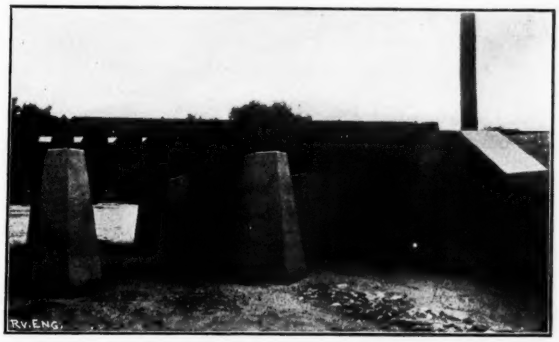
The Southern Railway is to build at Spartanburg a modern freight terminal consisting of separate inbound and outbound warehouses with ample team track facilities. The whole will involve construction to cost in the neighborhood of $100,000.00. Authority for these improvements has been granted and bids are being solicited from contractors.

The new buildings will consist of a one-story inbound freight house 40x198 ft., with two-story office section 40x52 ft., the building to be of brick, with concrete floor.

A MODERN STORM DRAIN TEST

By Albert Marple.

The severe storms which occur almost without warning in Southern California, have made it necessary for the railroads, as well as the cities and counties, to erect, in the time of fair weather, storm drains which are capable of handling the large amounts of water at the time the downpours occur. It has not been so many years since the people of that section found that it was wise to keep the improvements from washing away, rather than repair them after they had been damaged. This



Close view of drain, showing piers.

was true with the railroads as well as with the other large corporations and the municipalities.

The Pacific Electric Railway company was one of the first institutions to recognize the fact that the "permanent and safe" feature is the cheapest in the long run. It learned this through hard experience. In the winter or rainy season this company suffered much from washouts, in many instances the tracks being washed away and traffic being suspended for days and even weeks. The carrying away of culverts and the crippling of trestles was an ordinary occurrence.

It was in the building of the electric line along the base of the foothills to the various cities and towns in that section from Los Angeles, that this company found

Entrance to drain is more than a mile.

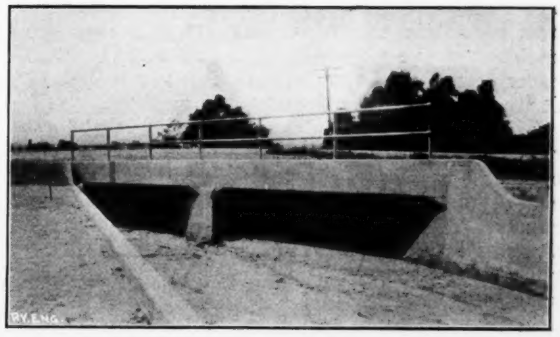
it necessary to construct, in conjunction with the supervisors of Los Angeles county, the storm drain shown in the illustrations.

This drain or ditch is about 500 ft. in length and 24 ft. in width, the walls on either side being about four and a half feet in height, 6 ins. thick at the top and 12 ins. at the bottom. The bottoms of the walls rest upon foundations which are 6 ins. in thickness and 2 ft. in width. In addition to the 4½ ft. above the ground the walls continue for about 3 ft. beneath the surface of the sand.

The entrance to this drain is about a mile distant from the mouth of the San Gabriel canyon. Ordinarily there is but a small stream running out of this canyon, but in the event of a heavy rain this is swelled by the water which drains from the hills on either side to such an extent that the stream is increased to almost the force of a raging torrent. The level land just outside the can-

View of top of storm drain

yon's mouth often becomes so water-soaked on account of previous rains, that the earth refuses to take more moisture, and for this reason it is practically all compelled to run away. After leaving the canyon the stream, on these unusual occasions, widens to about half a mile, only to narrow again at the point where this drain is



Waterway below railroad

located. The engineers were not slow in taking advantage of this natural and advantageous condition. After passing beneath the railroad trestle the water continues along this ditch, beneath the concrete bridge, over which the country high road runs, and out of the lower end.

This railway bridge, which contains a double-track

Storm drain with high side walls.

road, is about 30 ft. in width and as long as the ditch is wide. Beneath this bridge there are three strong concrete supports, these being 6 ft. apart, measurements being taken from center to center of piers. These piers are 5 ft. in height, 18 ins. thick at the top and 2½ ft. at

the bottom. Like the wall, these are buried 3 ft. in the sand, being placed upon foundations, each of which is 8 ins. thick and 5 ft. wide. The piers are pointed at the ends so as to cut the water when it comes in contact with them. Indentations were left in the tops of the piers to accommodate the four large beams, which extend entirely across the trestle and support the ties of the track.

The highroad bridge, at the opposite end of the ditch, is 50 ft. in width and 6½ ft. high. The facing across the side is 2 ft. in width and the single support, which runs the entire length of the structure, is 10 ins. in thickness at the bottom, tapering gradually toward the top, at a point 6 ins. from which it is 8 ins. in thickness. At this point the support flares outward and at the place where it connects with the under side of the bridge, it is 18 ins. thick. This support, also, is situated upon a wide concrete base. Both of the bridges and the walls are reenforced by twisted steel rods, these being so placed, both vertically and horizontally, as to form one-foot squares.

A STANDARD STATION CLOCK

We show this month a suggestion which may be useful to some of our friends who have to design station buildings or at least have to specify what shall be the general form of useful appliances or more or less ornamental facilities. The clock represented is intended to be for outside decoration, as well as forming a utilitarian item of station equipment. The clock may go in the pediment over a main doorway or on a tower or on the upper part of the bow-window which is usually set apart for the ticket seller or the telegraph operator.

The curious feature about this clock is that the usual circular clock dial is absent and has been replaced with one of oblong form with the major axis vertical. This enables the clock to occupy less space than the one of circular form, and if placed on a tower, the narrow-shaped clock would tend to enhance the vertical or long upright-line idea which might possibly be a marked feature of the design.

The figures are arranged so that the 12 and the 6 are on the top and bottom of the vertical line through the centre of the clock. The figures 2, 3 and 4 are on a vertical line to the right, and 8, 9 and 10 are on a similar vertical line to the left. The figures 1, 5, 7 and 11 are placed in the corner positions, 1 and 11 a little below and between the 12 and the top of the outside rows. The figures 5 and 7 are above the 6 and between it and the outside vertical rows. This is the general scheme on which the dial of the oblong clock is laid out, but each designer must fix the proportions for himself.

The hands of the clock are like ordinary clock-hands. Their ends travel in circles. One way in which a designer may make use of this plan is by making the point of the minute hand just touch the lower edge of the figure 12. When this hand gets to 3 it would reach to the outer or farthest side of the figure. This might be done with hour hand, if preferred, and the minute hand reach well into the 12, and completely overpass the figure 3. In this latter case the point of the minute hand would run over a portion of the ornamental pilasters which form the sides of the clock.

It is quite possible to tell time readily from a dial of this form because civilized mankind has been for so long familiar with the clock dial that figures designating hours are not necessary. An example of this may be seen on the City Hall at Philadelphia or on the Royal Liver Building, at Liverpool, Eng., or on the Colgate clock in Jersey City, N. J. In the oblong clock, figures are not absolutely necessary, and the relative position of the point of a clock hand on the figure, or its substitute, is really a matter of no importance. The fact that the point is "long" on 3 and short on 12 does not confuse the man looking for the time, because he does not stay there long enough to realize that the relative position of hand-point and figure will later vary from what he then sees. The important point for the designer is to arrange matters so that the hour and minute hands do not become confused by being too nearly the same length. The hour hand, for that matter, does not require to touch the figures at all.

In our illustration we have shown the pilasters as carved so as to suggest hour-glasses; the one to the right with the "wee sma' hours," shows the glass beginning to run, thus indicating, future time. The glass to the left with sand nearly spent typifies time past. Above the clock the monogram of the road, or the Eastern, Central or Pacific time could be designated, or any motto appropriate to the work might be shown, such as that by Bishop Berkeley on the prospect of planting arts and learning

Oval station clock

in America. Thus he wrote some time before 1753; and said, "Time's noblest offspring is the last." Or Macbeth's grim comfort to himself, "Time and the hour runs through the roughest day." Berkeley's words might not inappropriately be taken to include or indicate, on a station clock, a reference to the great art of transportation which is to America the foremost of the many marvelous quasi-public services which help to make our lives what they are, as we look to our railways for domestic traffic and for commerce with the world outside.

There is practically no limit to the artistic development of the clock as an architectural feature of a station building. The station and all about it is a standing advertisement of the road. It is a mute setting forth to the public of the kind of service they may expect. It may or may not be a true indication of this, but the public is insensibly led to judge by what it sees. Many railways have

grasped the advertising value of artistic stations and grounds; and many times over has it been proved that good taste and good service are not antagonistic. The clock here shown is but an outline of the idea. The sides might perhaps be adorned with medallions or long oval facial representations of shrouded night or smiling morn. The oblong clock itself suggests a transparency for illumination at night on which a railroad scene might be found to suit. Even a sun-dial effect could be produced—that ancient form of time-telling which "counts but the sunny hours."

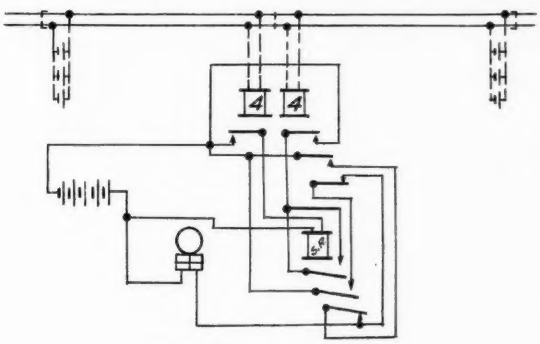
A form of clock inside, with pendulum for regulation by the station-master, or a self-winding clock set to the telegraph time signal, to keep it always true, might when once installed be found most useful, inexpensive to maintain, and of a high artistic value on any station building, in a small but rising town, as well as suitable for the more pretentious or commanding edifice.

EFFICIENCY OF THE HIGHWAY CROSSING ALARM

By H. P. Hancock, Chief Draftsman, N. C. & St. L. Ry.

The highway crossing alarm is the purely public protective signal. The automatic block signal and interlocking devices, besides giving increased protection to trains it also facilitates traffic and the managements of many railroads are beginning to realize that such signals and devices, aside from their protective features, are paying investments, but the merit of the highway crossing alarm is entirely dependent upon the protection that it affords to the public.

The highway crossing alarm, being a purely protective



Wiring for highway alarm.

signal, from an economical standpoint, the railroad company must install such a signal on the basis that the money invested in the first cost and installation, plus the cost of maintenance and upkeep divided by the number of years estimated as the life of the bell, must not more than equal the interest on the money saved by the decreased yearly liability of an accident which is given by the alarm.

There are dangerous crossings on nearly all railroads which the management would like to have protected, if such protection could be given when supported by the foregoing method of reasoning, but since the decrease in the liability of an accident afforded is too expensive, the only way to warrant the installation of an alarm at such places is to decrease the factors of expense without decreasing the reliability of the alarm.

The accompanying drawing shows how all this may be accomplished.

In the majority of cases crossing alarms are either installed in automatic or interlocking territory, or else placed, with the idea that in the installation as many standard automatic or interlocking appliances may be used as possible, so that these may be employed in conjunction with the above named signals. It will be observed from the sketch that the usual interlocking relay is done away with and an ordinary neutral type line relay wired, as a stick relay is substituted, thus decreasing the first cost by the difference in cost between the interlocking and neutral type of relays, and at the same time by having standard track relays which may be used in conjunction with other signals.

It will also be observed that as soon as the train reaches the crossing, the alarm automatically cuts out. This brings about a saving of at least 30 per cent. of the operating battery maintenance cost, thus decreasing the cost of upkeep, besides eliminating the disagreeable sound experienced by passengers who are trying to sleep at night, and decreasing the annoyance to residents in the vicinity.

Since the action of the neutral type relay is more positive than that of the interlocking relay, the reliability of the alarm is increased, and since the parts of the neutral type relay are simpler, it requires less inspection and less care, which decrease the maintenance cost.

GOVERNMENT-OWNED RAILROAD

President Woodrow Wilson controls at least one railroad and has the authority to issue passes over it. He is, by virtue of his office, nominal president of the only standard gauge railroad in the United States built and operated by the government. It is the Arrowrock line constructed by the Reclamation Service to carry supplies from Boise to the irrigation dam 20 miles above the city. The railroad is a paying common carrier from the earnings of which a surplus has been turned into the United States treasury. This road is in operation now and has been for the past four years, having been built in 1911.

When the task of erecting the Arrowrock dam across the Boise River was conceived, the problem of transporting the supplies to its site had to be solved. This resulted in the decision to build the railroad. It was constructed with a maximum grade of 1½ per cent and a maximum curvature of 12 deg. up the Boise river canyon, and was a success from the start. The road is now in constant operation, fully equipped with government rolling stock. Without it, the government would have been seriously handicapped in erecting this dam 351 ft. high and weighing over a million tons.

Since its operation this road has earned a net surplus of $62,334.09. Its total freight earnings are $238,713.36; its switch earnings have amounted to $506.50. A total of $50,212.75 was taken in for passenger fares of which the government paid $1,811.25, tickets and cash fares amounted to $48,272.82 and there was excess baggage of $128.68 collected. The miscellaneous earnings of the road amounted to $984.40, bringing the total gross earnings up to $290,417.01. The total operating cost amounted to $228,062.92. The train mileage up to July 1, 1915, was 105,129 with an operating cost per mile of $2.17. There were a total of 63,327 passengers carried. The freight hauled reached 13,826,401 ton miles, of which 60,314 was commercial, 1,894,754 government supplies and 11,871,323 gravel and sand.

This railroad reaches the site of the big dam which will be dedicated October 4 with appropriate ceremonies in the city and at the dam. This date will also mark the completion of the Boise project composed of 243,000 acres, tributary to Boise, Caldwell and Nampa.

QUALITIES OF GOOD STEEL RAILS

Rails are but bridges whose safety should be as much beyond question as that of the larger structures. Mr. G. Lindenthal, consulting engineer of New York said something like this in his opening remarks to the N. Y. Railroad Club not long ago. When rails of ordinarily sound steel break under ordinary wear and tear, as they do now, the are not strong enough. That is the only correct conclusion to come to. The first requisite for good rails is good steel, and we must insist on good ingots to commence with. The weight of accumulated experience indicates that in this country the bulk of heavy steel rails will more than likely be made of basic open hearth carbon steel with carbon between 0.75 and 1.00 per cent., provided that phosphorus and sulphur be kept low.

It is generally believed that small blow holes are not harmful, because they can readily be welded up in the rolling. Larger blow holes can be avoided by the addition of aluminum, in the form of small shot put at the bottom of the ladle before filling it. Ferro-titanium and fero-silicon are used for the same purpose Aluminum and Titanium do not form alloys with steel, they act as deoxidizers Titanium removes Nitrogen, forming nitrates and fluid slag. Oxides, sulphides and other chemical impurities and any particles of furnace lining, will, if given sufficient time, float up and into the slag on top. Ten minutes or so, depending on local conditions, should be allowed for this to take place. The present practice is often too fast.

Aluminum while it reduces blow-holes increases piping, and piping facilitates segregation. This is the natural process by which certain chemical combinations, alloys and impurities work out to the surface of the freezing metal, and form an interior pipe. The pipe is therefore the home of segregation. This is generally treated as an unavoidable and unfortunate evil. The only protection afforded so far is the discard from the upper part of the ingot.

The extent of the pipe varies in each ingot, and the amount of discard required is therefore peculiar to any individual ingot. The pipe may extend from 15 to 80 per cent. The amount of the discard is usually assumed at some convenient percentage. The adherance to this figure is practically in the hands of the manufacturer, and his interests are not those of the consumer. The remelting of discards costs $5 a ton. If the extent of the discard could be readily ascertained for each ingot, it would be easy to compensate the railmaker for the remelting. This has not been practicable, and even a discard of 30 per cent. has been found to provide no real protection. It is to this "hit or miss" method that the largest share of blame for unsound steel rails must be ascribed.

All existing specifications permit the finishing of rails at too high a temperature. This is evident from the large shrinkage allowance at the saw, 5½ to 7⅜ ins. for a 33-ft. rail, when it should be 4 ins. The highest finish contributes, but is not the sole cause of coarse crystaline structures in the thick part of the rail, i. e., in the head where fine grain is most wanted. High carbon steel is more sensitive to variations of heat and requires more skillful work, than the low-carbon structural steels. The heating of ingots should be done with a non-oxidizing flame, so as not to affect composition of the steel in the region of the flame.

Railmakers have a good excuse for high temperature finish, on account of the thin webs and flanges in heavy rail sections. The thin parts would otherwise become too cool, while the head was still hot. Reform must therefore begin with the rail section. Web and flange should if possible be made thicker and head thinner. The critical temperature appears to be that of recalescence or re-glow of the cooling metal, when the magnetic and electrical properties undergo some change. This is at 675 degs. C.; below this continued work may become more harmful than useful. Between 1000 deg. C. and 675 degs. C. continuous rolling, forging or kneeding has the effect of producing a fine grain. More time should be devoted to the last five or six passes of the rail through the rolls.

The 125-lb. rail on the P. R. R. has the same stiffness as the 135-lb. rail on the C. R. R. of N. J., which is the heaviest rail in the United States, but the saving of 10 lbs. effected by the Pennsylvania, results from a better distribution of metal. The head is lighter and the base narrower than the heavier rail, and this provides better rolling properties. Among the points taken up in the summary are: 1, Heavier rail sections for the present heavier wheel loads. 2, In the fabricating, holding the metal in the ladle 10 min. for self-cleaning. 3. Pouring ingots large end up, with a sinkhead. 4, Rerolling rails from reheated cold blooms. 5, Reducing speed of rolls in the last few passes to, say, 4 ft. a second. 6, Have finishing temperature below 7.50 degs. C. 7, Experiment with double webbed rail for heavy sections with the probability of finer grain and longer wear in addition to greater strength and safety of the rail. (This last refers to the U-section rail.)

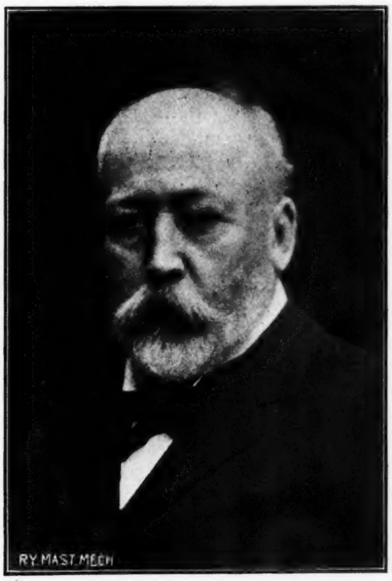
Passing over the animated and not wholly concurring discussion on other points, which followed, it is interesting to note the origin of the 135-lb. rail on the C. R. R. of N. J. as given by Mr. James Osgood, chief engineer of that line. He said, the section was designed in 1909 when the heaviest rail in the road was 90 lbs. Am. Soc. C. E. section. This lighter rail was used on curves, part of them Bessimer and part open hearth, as hard as we could get. On sharp curves the wear was heavy. Mr. C. W. Huntington and Mr. Osgood made a study of conditions and performance and decided that a special open hearth steel rail of heavy section, to permit a high carbon content, was worth an experiment.

In the experimental rail 50 per cent. was added arbitrarily to the 90-lb. rail and the 135-lb. rail resulted. Before a final decision was reached, most of the mills were consulted. The same "fishing" was used as in the 100-lb. rail, Am. Soc. C. E., but the C. R. R. of N. J. section was different, being comparatively low for the weight, with large, broad head, somewhat stocky, and designed to meet conditions in curved track with heavy traffic. Its moment of inertia was found to be 72.39 or more than double that of the 90-lb. rail (the stiffness of the rail, that is, its capacity to distribute the wheel load on the ties, is measured by the moment of inertia of its section, and its strength by its section modulus). Some rails which failed, when analyzed, were found to contain as high as 1.16 to 1.23 carbon. These excessively high carbon rails showed a disposition to split off along the outside of the head on the low rail of the curve, in the path of the false flange on worn wheels. Owing to the widening of the gauge on sharp curves it drew the wheels onto a line just outside the web of the rail. Only one cross fracture, however, appeared in these rails. No derailment occurred by reason of these rails failing.

The result of the experiment was so satisfactory that the railroad has continued to buy 135-lb. high carbon steel rails. These rails have a life three times that of the 90-lb. rail which they replaced, and the financial result as well as that of the experiment in the use of track, has proved to be very satisfactory.

Personal Items for Railroad Men

SIR WILLIAM C. VAN HORNE.—No better example of the high quality of the human element, which is of so much consequence in railroad operation, ever lived than Sir William Van Horne. He stands prominently forward as an instance of a man who started at the very bottom and because he was made up of the right material, reached the topmost round of the ladder and died famous. His successes were legion and his popularity was founded upon the golden rule that "he did unto others as he would they should do unto him." His 73 years of life were rounded



William Cornelius Van Horne.

out into an immeasurable compass. From a railroad office boy at 14, he moved into one position after another and was advanced on his merits, until he became a general superintendent; a general manager; and president and finally chairman of the board. These latter positions with the Canadian Pacific. From 1881 down to his death, which occurred on September 11 of this year at Montreal, he was closely and especially identified with this great Canadian railway. He was at the same time interested in many other corporations. Sir William received his title in 1904. He was a member of many clubs and many societies; was one of the great art collectors on this side of the Atlantic; and was an artist as well. He was known as the "Hill & Harriman" of Canada, and was instrumental in making the Canadian Pacific one of the greatest railways in the world. He died covered with honor and was universally respected. William Cornelius Van Horne was a great man.

JOHN J. SEXTON has been appointed Trainmaster on the Northern Pacific with headquarters at Billings, Montana, vice Mr. R. R. Auerbach, promoted.

C. L. POLAND has recently been appointed Roadmaster for the Kansas City, Mexico & Orient R. R., with headquarters at Benjamin, Tex., succeeds Mr. C. A. Finke.

W. H. P. FISHER has been appointed Sales Manager of the L. M. Booth Company, of New York, manufacturers of Booth Water Softeners. He will make his headquarters at the Engineering Department, Jersey City, N. J.

R. L. HOLMES recently appointed Asst. Eng. of the Texas & Pacific R. R. at Dallas, Tex. entered the service of that Road in 1899, served in the capacity of rodman, instrument-man and Asst. to the Div. Eng. of various Divisions until in 1911 he was appointed Div. Eng. of the Eastern Div. In his recent appointment as Asst. Eng. Mr. Holmes succeeds W. F Kane, resigned, and is succeeded by H. P. Moberley.

W. H. RAMSEY, recently appointed General Manager and Chief Engineer of the Guantanamo R. R., at Guantanamo, Cuba, succeeds Richard Brooks, who has accepted a position as assistant to the manager of the United Railroads in Havana. Mr. Ramsey's previous service includes ten years in the public work department, Jamaica, British West Indies, and from 1900 to 1914 Chief Engineer of the Banes Division of the United Fruit Company R. R. in Cuba.

F. J. BLAUVELT, recently appointed Supervisor of Tracks of the Lehigh Valley Railroad, with headquarters at Cortland, N. Y., began railroad work in 1903 as stenographer for the Division Engineer. About six months later he was promoted to rodman on the Engineering Corps and advanced through the several positions on the corps to Assistant Division Engineer. For a short time in 1913 and 1914 Mr. Blauvelt was appointed Acting Division Engineer pending the appointment of a man to fill this position, after which he resumed his duties as Assistant Division Engineer until he recently succeeded John Manion, resigned.

L. V. MANSPEAKER recently appointed Asst. Eng. of the Southern and Western Div. of the Chicago and Alton R. R. entered the service of the Mo. Okla. and Gulf Ry. in 1909 on construction work from Muskogee, Okla., to Sherman, Tex., and was also connected with construction work for the La. & Arkansas Ry. In 1910 Mr. Manspeaker was appointed constructural engineer for the Madeira, Mamorie Ry., in Brazil, on a construction of their line on the frontier between Bolivier and Brazil. When this work was completed he returned to the U. S. in 1912. and has been connected with the Chicago and Alton R. R. until his recent appointment, succeeding Mr. G. L. Barkley, who is resigned on account of ill health.

HUGH MCCARTHY recently appointed Train Master of the Minn. & St. L. R. R. at Marshalltown, Ia., entered the service of the Ia. Central Ry. in 1896 as clerk to the Div. Rdmstr. In 1897 he entered the Auditor's office of the I. I. & I. at Kankakee, Ill. In 1900 he became timekeeper and asst. foreman of maintenance of way on the O. R. & N. Ry. and in 1902 entered the Auditor's office at Portland, Ore. Shortly after he became brakeman for the Ia. Central Ry. and after that served as conductor for four years. In 1907 he became switchman for the M. & St. L. at Albert Lee, Minn. Since then he has held successively the positions of Ch. Clerk to the Div. Supt., Gen. Yardmaster at Minneapolis, and succeeds Mr. G. W. Barr, resigned.

John James Malroy has recently been appointed trainmaster for the Northern Pacific Railway, with headquarters at Jamestown, N. D.

Thomas M. Flynn, recently appointed trainmaster for the Northern Pacific Railway at Glendive, Mont., succeeds there J. J. Sexton, transferred.

William C. Sloan has been appointed Trainmaster on the Northern Pacific with headquarters at Forsyth, Montana, vice Mr. Thomas M. Flynn, transferred.

Walter D. Pearce, recently appointed supervisor on the Yellowstone Division of the Northern Pacific Railway with headquarters at Glendive, succeeds William C. Sloan, promoted.

L. V. Small, supervisor of track on the C. C. C. & St. L. Ry. lines at Harrisburg, Ill., entered the employ of that company in 1896 and until 1914 served as section foreman in the winter and as extra gang foreman in the summer. In 1913 Mr. Small was transferred to the Whitewater Division after the flood and took charge of the reconstruction work of that division for seven months.

J. A. Walker, recently appointed assistant roadmaster for the Southern Railway on the Birmingham Division, entered the employ of the Southern Railway in 1899 as a section laborer. In 1902 he was appointed bridge carpenter and in 1909 bridge foreman. In 1914 Mr. Walker was made general foreman of maintenance of way, which position he held until the announcement of his recent appointment.

Ben B. Johnson, recently appointed chief dispatcher and division operator of the Pasco Division of the Northern Pacific Railway, with headquarters at Pasco, Washington, after serving as day chief dispatcher at Missoula, Paradise and Spokane, served as chairman of the examining board and later as night chief dispatcher. In 1909 he was appointed dispatcher at Missoula, which position he held until his recent appointment at Pasco.

Chas. Glithero, recently appointed superintendent of bridges and buildings on the Galveston, Harrisburg and San Antonio Railway, entered the employ of that company in 1881 as a bridge laborer. In 1886 he was made foreman and served in that capacity until his recent promotion to the position of superintendent of bridges and buildings, following the retirement of his predecessor, Mr. H. Small, who was pensioned at the age of 70 years.

Richard Brooks, recently appointed assistant to the general manager of the United Railways of Havana, was, previous to his present appointment, general manager and chief engineer on the Guantanamo R. R., Cuba, for about ten years. Previous to that he served for nine years in the public works department, British India. Mr. Brooks succeeds Malcolm L. Masteller, who has been appointed general manager of the Gucaro-Moron and Camaguey-Nuevitas Railways, Cuba.

V. C. Randolph, recently appointed assistant superintendent of the Erie Railroad at Susquehanna, entered the service of the Erie Railroad as machinist's apprentice in 1882. Between 1886 and 1902 he served as locomotive fireman and engineer and then for eight years as airbrake instructor. The following two years he was supervisor of locomotive operation, and in 1912 was appointed master mechanic of the Rochester Division, which he held until the date of the above appointment.

C. H. Doorley, recently appointed acting superintendent of the Gary Division of the Elgin, Joliet, and Eastern Railway with office at Gary, Ind., entered the service of that road in 1900 as night yard master and in 1902 was appointed general yard master. In 1908 he became assistant superintendent of terminals of the Gary Division and April 15, 1915, was appointed superintendent of terminals with office at East Joliet, which position was abolished when Mr. Doorley was appointed acting superintendent of the Gary Division.

C. H. Mann, recently appointed superintendent of scales of the Southern Railway, entered the service of that road in 1905 in the office of the general superintendent of motive power. Since that time he has held successively positions in the office of the assistant general manager and the general storekeeper of the Southern Railway. He next became secretary to the chief engineer of maintenance, then secretary to the assistant chief engineer, inspector and assistant to the superintendent of scales. Mr. Mann succeeds, as superintendent of scales, F. J. Cruikshank, who has resigned from the service.

H. H. Oppelt was recently appointed supervisor of bridges and buildings on the New York, Chicago and St. Louis Railroad. Before entering the service of that road he was employed on the Pan Handle Division of the Pennsylvania Railroad He entered the employ of the New York, Chicago and St. Louis Railroad in 1886 as foreman of a force of bridge carpenters. Since that time Mr. Oppelt has held successively the positions of supervisor of water service, supervisor of signals and interlocking and assistant supervisor of bridges and buildings. He succeeds Mr. I. Cole, who was retired on account of having reached the age limit.

OBITUARY.

Winfield Scott Tinsman, chairman of the General Managers' Association of Chicago and chairman of the Association of Western Railways, died Wednesday, September 15, at Rochester, Minn., following an operation on his throat, which had been found necessary on account of Mr. Tinsman's general ill health for over two years.

Mr. Tinsman was born at Berryville, N. Y., September 8, 1867, graduated from the public schools in May, 1882, and entered the service of the Chicago, Rock Island and Pacific the same year as messenger. In 1885 he was appointed telegraph operator, in 1888 train dispatcher and in 1890 chief train dispatcher at Trenton, Mo. In 1897 Mr. Tinsman became train master at Horton, Kansas, and in 1901 he was made superintendent of Chicago terminals. In 1902 he was appointed superintendent of the Oakland Division and later was transferred to the Missouri Division in the same capacity. In 1905 he became general superintendent of the Choctaw District, in 1906 was appointed general superintendent of the Southwestern District, and in 1907 he became assistant general manager, and in 1908 manager of the Southern and Choctaw districts.

In 1909 Mr. Tinsman was made general manager of the entire system, and in February, 1912, assistant to the president of the Rock Island.

In October, 1912, Mr. Tinsman was appointed chairman of the General Managers' Association of Chicago and later he became chairman of the Association of Western Railways.

The Canadian Northern Company awarded a contract to the Roberts and Schaefer Company, on September 13th, for a large Standard Counterbalanced Bucket Locomotive Coaling Plant for installation at Kamloops Junction, B. C.